Acute Kidney Injury in Elderly Patients in Thai-Surgical Intensive Care Units (THAI-SICU) Study

Konlawij Trongtrakul MD*[1], Sujaree Poopipatpab MD*[2],
Chawika Pisitsak MD*[3], Kaweesak Chittawatanarat MD, PhD*[4],
Sunthiti Morakul MD*[3], the THAI-SICU study group

*[1] *Department of Emergency Medicine, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand*
*[2] *Department of Anesthesiology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand*
*[3] *Department of Anesthesiology, Faculty of Medicine, Ramithibodi Hospital, Mahidol University, Bangkok, Thailand*
*[4] *Department of Surgery, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand*

Objective: *To demonstrate prevalence, characteristics and outcomes of the elderly patients who were diagnosed with acute kidney injury (AKI) in surgical intensive care units (ICUs).*

Material and Method: *AKI data were extracted from multicenter prospective cohort study conducted in 9 university-affiliated surgical ICUs in Thailand (THAI-SICU study) from April 2011 to January 2013. The elderly group was defined as those over 65 years old. Statistical analysis was done comparing baseline characteristics and outcomes between the elderly with AKI and those without.*

Results: *A total of 2,310 elderly patients (49.7%) were identified in our surgical ICUs from a total 4,652 cases. Of this elderly group, AKI was diagnosed in 445 cases (19.3%). The differences in the baseline characteristics of the elderly with AKI group were: older, higher number of males, greater number of smokers, and greater disease severity evaluated with APACHE-II and SOFA score than the elderly without AKI. The ICU mortality and 28-day hospital mortality were higher in the elderly with AKI than those without (28.1% vs. 5.2%, p<0.001 with RR = 5.401, 95% CI 4.231-6.895 and 35.7% vs. 9.4%, p<0.001 with RR = 3.786, 95% CI 3.138-4.569, respectively). Using multivariable logistic regression analysis and after adjustment of covariates, independent potential risk factors of developing AKI in the SICU included: older age, higher APACHE-II and SOFA score, smoking history, emergency surgery, concurrent sepsis, cardiac complications, delirium, and requiring respiratory support during ICU stay.*

Conclusion: *Geriatric patients made up almost half of our surgical ICU population and nearly one-fifth of them suffered AKI. Once they had AKI, ICU mortality and 28-day hospital mortality were higher than those without AKI.*

Keywords: *Acute kidney injury, Elderly patient, Surgical intensive care unit, Risk factors, Intensive care unit mortality*

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Acute kidney injury (AKI) is a rapid decline in kidney function leading to dysregulation of fluid, electrolytes, and metabolic waste products. The occurrence of AKI is often found in the intensive care unit (ICU), and affects between 22-67% of patients(1-3). Advanced age is one of the potential risk factors for developing this problem(4-6). However, the information about AKI in elderly SICU patients is limited globally; recent years have seen an increase in the elderly populationin our society(7).

Kidney structure and function change overtime with aging; for example, a decrease in renal mass(8) and increase in amount and degree of glomerulosclerosis(9). In addition, there are coincident renal physiological alterations, such as decline in glomerular filtration rate(10), loss of urinary concentrating and diluting ability(11), reduction in sodium conservation(12), and diminished vasodilatory capacity in response to renal hypoperfusion(13). Moreover, elderly comorbidities can promote greater susceptibility to kidney damage (i.e., hypertension, diabetes mellitus, atherosclerosis)(14).

Due to limited epidemiological data about elderly AKI cases in surgical ICU in Thailand, the aims of this study were to demonstrate differences between

Correspondence to:
Morakul S, Department of Anesthesiology, Faculty of Medicine, Ramithibodi Hospital, Mahidol University, Bangkok 10400, Thailand.
Fax: +66-2-2011552
E-mail: sunthiti@hotmail.com

elderly with AKI and those without using (1) demographic data, (2) characteristics of elderly or potential risk factors for developing AKI, and (3) comparing outcomes between these two groups. Changes to public health policy and ICU care planning for elderly patients could be established following this evidence.

Material and Method

This study recruited the older population from the multi-center study undertaken in collaboration among nine outstanding university surgical ICUs in Thailand (THAI-SICU study)[15]. Data were collected from April 2011 to January 2013. Elderly patients were defined as 65 years and above[16] and then divided into two subgroups according to AKI diagnosis (older with AKI and those without). THAI-SICU study protocols were submitted to and approved by individual ethics and research committees at each institution.

Data collection

The prospective data collection included: elderly demographic data, such as age, sex, body mass index (BMI); smoking status; principal diagnosis at ICU admission; pre-existing comorbidities; severity of patient admission evaluated by APACHE-II and SOFA score (within first 24 hours of ICU admission); ICU admission prioritization[17]; source and type of ICU admission; surgical type, site of operation, and American Society of Anesthesiologists physical status (ASA-status) were also collected.

The ICU admission priority-I comprises of critical and unstable illness requiring intensive treatment and monitoring that cannot be provided outside of the ICU, and patients have no limits placed on the extent of therapy they are to receive because they have a significant likelihood of recovery. Priority-II comprises of patients requiring intensive monitoring because they may need immediate intervention without therapeutic limitation. Priority-III comprises unstable critically ill patients but with a low likelihood of recovery because of the severity of acute diseases and comorbidities, that means these patients need treatment to relieve their acute illness. Priority-IV includes patients who have little or no anticipated benefit from ICU admission; however, limits on therapeutic efforts may be set based on individual or unusual circumstances, and at the discretion of the ICU director. ASA-status categories are: ASA-I, normal healthy patient; ASA-II, patient with mild systemic disease; ASA-III, patient with severe systemic disease; ASA-IV, patient with severe systemic disease that is a constant threat to life; ASA-V, moribund patient who is not expected to survive without surgery; and ASA-VI, a declared brain-dead patient whose organs are being removed for donor purposes.

AKI diagnosis is, based upon the Acute Kidney Network (AKIN) definition: an abrupt increase in serum creatinine of at least 0.3 mg/dL or increase equal to or above 1.5-times from baseline within 48 hours. AKI is then classified for severity: AKIN-stage 1, increase of serum creatinine of at least 0.3 mg/dL or increase 1.5-to 2-times above baseline; AKIN-stage 2, increase in serum creatinine above 2-to 3-times, and AKIN-stage 3, increase in serum creatinine above 3-times or creatinine greater than or equal to 4.0 mb/dL with an acute rise of at least 0.5 mg/dL, or individuals who receive renal replacement therapy (RRT) regardless of the stage of AKIN[18].

In diagnosing AKI in our study, at first we screened AKI daily using AKIN definitions as mentioned above. Then AKIN-staging was considered according to the highest serum creatinine value during the ICU stay and compared with patient baseline serum creatinine. The baseline serum creatinine was selected from the lowest value between: (1) the lowest serum creatinine between hospital admission or in previous 3-month sample before admission, if patient had pre-existing chronic kidney disease; (2) calculating back from the Modification of Diet in Renal Disease (MDRD) equation by assuming patient's baseline eGFR at 75 mL/min[19].

Patient outcomes, including surgical ICU mortality and 28-day mortality after hospitalization were analyzed. In addition, length of ICU stay, length of hospital stay, duration of respiratory support, and renal replacement therapy (frequency and modality) were also evaluated.

Statistical analysis

Number and percentages were used to present patient discrete variables, whereas mean and standard deviation or median and interquartile range were used for continuous data. The difference in patients' characteristics and mortality (surgical ICU mortality and 28-day hospital mortality) were analyzed using Pearson's Chi-square or Fisher's exact test when appropriate for categorical data, and by Mann-Whitney U test or Student t-test when appropriate for continuous data. The risk ratios (RR) calculated risk of ICU mortality and 28-day hospital mortality of AKI over non-AKI elderly. The association of individual variables that promoted AKI was analyzed using bivariate logistic regression. Backward elimination multivariable logistic regression was done to identify variables that had a precise association to an occurrence of AKI, then full model multivariable logistic regression was retested to confirm the final model. The level of *p*-value remove was less than 0.20. The *p*-values less than 0.05 were considered statistically significant. The crude odds ratios (OR) of each variable and adjustment OR for significant variables that predicted AKI in the elderly were reported. Finally, Kaplan-Meier survival function curves, which were done to examine elderly survivors between AKI and non-AKI groups and hazard ratios (HR) were also calculated. This study used STATA, version 11.0 (STATA Inc., College Station, TX) for statistical analysis.

Results

A total of 2,310 (49.7%) elderly patients were enrolled from 4,652 participants in THAI-SICUs study. AKI was diagnosed (identified with AKI-screening criteria) in 445 cases (19.3% of elderly). For AKI severity staging by AKIN criterion (only 325 cases available for this information) AKIN-1, AKIN-2, and AKIN-3 were found in 117 (36.0% of available data), 73 (22.5%), and 135 (41.5%) cases, respectively.

Comparing the elderly with AKI and non-AKI baseline characteristics, there were of more advanced age, higher number of males, higher number of smokers and ex-smokers, and greater disease severity evaluated by APACHE-II, SOFA and non-renal SOFA score in AKI than those without (Table 1). Principal diagnosis of ICU admissionand pre-existing comorbidities were not different between these two groups (all *p*-value >0.05). In addition, patients' baseline serum creatinine were not statistically significant differences between groups ($p = 0.096$). The baseline serum creatinine was selected from a back calculation from the MDRD equation (1,738 (78.7%) cases), while the rest 470 (21.3%) cases were used previously 3-month or at hospital admission if patient had chronic kidney disease. Other laboratories included serum albumin and hemoglobin levels were lower in elderly with AKI than those without, while the amount of pulmonary infiltration on chest x-ray and abnormal baseline electrocardiogram was found much more in elderly with AKI than AKI-free patients (Table 1).

Table 2 shows the differences in both types and sources of surgical ICU admissions between elderly with AKI and those without (both $p<0.001$). Emergency surgery and chief medical complaint (such as sepsis, acute pancreatitis, acute cholangitis) that led to ICU admission were a predominant part of elderly with AKI, while elective surgery was a major feature of elderly without AKI admission. Although, most of the elderly were admitted from operative or recovery room regardless of AKI diagnosis, those transferred from emergency room and general wards seemed to have a higher incidence of AKI than those without. For ICU admission prioritization and ASA-status, elderly cohort with AKI had a higher number of unstable patients (priority I and III) and had more cases with severe ASA classification (ASA class III and IV) than elderly without AKI. In addition, types of surgery were different between groups ($p = 0.002$). Head, neck, and orthopedic surgery were much more common in elderly without AKI, in contrast to abdominal, colorectal, and other types of surgery, which were higher in AKI group (Table 2).

Outcomes of this study showed ICU mortality and 28-day hospital mortality were higher in elderly with AKI than those without (28.1% vs. 5.2%, $p<0.001$ with risk ratios (RR) of 5.401, 95% CI 4.231-6.895; and 35.7% vs. 9.4%, $p<0.001$ with RR of 3.786, 95% CI 3.138-4.569, respectively). The Kaplan-Meier survival function curve at 28 days was significantly different between 2 groups with the hazard ratios (HR) = 1.29 (95% CI, 1.03 to 1.62) (Fig. 1). The OR at each AKIN stage was compared with non-AKI; the ICU mortality increased corresponding with AKI severity: AKIN 1, 2, and 3 were 2.301, 6.058, and 9.400, respectively. Like OR in AKIN stages of 28-day hospital mortality, they were elevated at 2.174, 4.210, and 6.044, respectively. Moreover, longer ICU and hospital stay were identified more in AKI than non-AKI elderly patients (5 (2-13) days vs. 1 (1-3) days, $p<0.001$ and 17 (10-29) days vs. 15 (9-25) days, $p = 0.007$, respectively). Moreover, there was a higher percentage of mechanical ventilator support (86.1% vs. 51.6%, $p<0.001$) and longer duration of mechanical ventilation (5 (2-13) days vs. 2 (1-4) days, $p<0.001$) in AKI group than non-AKI (Table 3). Co-morbidities of the elderly ICU patients were found to be statistically different in AKI group from non-AKI including: sepsis, delirium, acute lung injury/acute respiratory distress syndrome, and myocardial infarction and new onset of arrhythmia (all $p<0.001$) (Table 3).

Patient severity using APACHE-II and SOFA score, current smoker, emergency surgery, sepsis, myocardial infarction and new onset of arrhythmia, and respiratory support during ICU stay were found as independent variables associated with an increased

Table 1. Baseline characteristics of elderly surgical intensive care patients with acute kidney injury versus those without

Baseline characteristics	All Elderly (n = 2,310)	Elderly with AKI (n = 445)	Elderly without AKI (n = 1,865)	*p*-value
Age (year-old)	75.8±7.0	76.6±6.8	75.6±7.0	0.005
Male (n (%))	1,329 (57.3)	289 (64.9)	1,040 (55.8)	<0.001
Body mass index (kg/m^2)	22.32±4.54	22.16±4.43	22.37±4.56	0.383
APACHE-II score*	12 (8-16)	16 (12-22)	11 (8-15)	<0.001
SOFA score*	2 (1-5)	5 (3-8)	2 (0-4)	<0.001
SOFA score (non-renal)*	2 (0-4)	4 (2-7)	1 (0-3)	<0.001
Smoking history				<0.001
Current smoker (n (%))	165 (7.1)	48 (10.8)	117 (6.3)	
Ex-smoker (n (%))	679 (29.4)	152 (34.2)	527 (28.3)	
Non-smoker (n (%))	1,466 (63.5)	245 (55.1)	1,221 (65.5)	
Principle diagnosis at ICU admission				0.052
Cardiovascular problems (n (%))	490 (21.2)	103 (23.1)	387 (20.8)	
Respiratory problems (n (%))	174 (7.5)	38 (8.5)	136 (7.3)	
Abdomen problems (n (%))	935 (40.5)	181 (40.7)	754 (40.4)	
Neurological problems (n (%))	87 (3.8)	7 (1.6)	80 (4.3)	
Renal problems (n (%))	188 (8.1)	42 (9.4)	146 (7.8)	
Sepsis (n (%)	81 (3.5)	21 (4.7)	60 (3.2)	
Trauma (n (%))	81 (3.5)	14 (3.1)	67 (3.6)	
Others diagnosis[&] (n (%))	274 (11.9)	39 (8.8)	235 (12.6)	
Pre-existing comorbidities (may be more than one)				
Hypertension (no.(%))	1,526 (66.1)	298 (67.0)	1,228 (65.8)	0.653
Cardiovascular diseases[!] (no.(%))	743 (32.2)	142 (31.9)	601 (32.2)	0.898
Previous stroke (no.(%))	213 (9.2)	32 (7.2)	181 (9.7)	0.100
Respiratory diseases[$] (no.(%))	290 (12.6)	54 (12.1)	236 (12.7)	0.766
Diabetes mellitus (no.(%))	627 (27.1)	120 (27.0)	507 (27.2)	0.926
Chronic kidney disease (no.(%))	263 (11.4)	60 (13.5)	203 (10.9)	0.121
Malignancy (no.(%))	370 (16.0)	77 (17.3)	293 (15.7)	0.410
Miscellaneous[#] (no.(%))	21 (0.9)	4 (0.9)	17 (0.9)	0.980
ICU admission investigation data				
Baseline serum creatinine (mg/dL)*	0.90 (0.78-1.04)	1.02 (0.80-1.10)	0.81 (0.75-1.03)	0.096
Blood sugar (mg/dL)	162±60	161±64	163±58	0.723
Hemoglobin (gm/dL)	10.6±2.0	10.3±2.1	10.7±2.0	<0.001
Serum albumin (gm/dL)	2.77±0.77	2.59±0.72	2.82±0.77	<0.001
Pulmonary infiltration on chest x-ray	516 (23.2)	152 (35.5)	346 (20.3)	<0.001
Abnormal electrocardiography	765 (34.9)	180 (42.3)	585 (33.1)	<0.001

* Reported as median and (interquartile range); [&] Other diagnosis included hematologic diseases, metabolic complication, gynecological diseases and musculo-skeletal diseases; [!] Cardiovascular diseases included coronary artery heart disease, congestive heart failure, vascular insufficiency diseases; [$] Respiratory diseases included asthma, chronic obstructive pulmonary diseases, and others; [#] Miscellaneous included immunological diseases, and organ transplantation.
APACHE-II score = Acute Physiology and Chronic Health Evaluation II score; SOFA score = Sequential Organ Failure Assessment score; ICU = intensive care unit

risk of AKI after analyzing with multivariable logistic regression and adjustment for covariates (Table 4). Finally, renal replacement therapy (RRT) was done in 76 cases (23.4% from 325 AKI available data) or 96 sessions of RRT (some patients had more than one modalities). The commonest mode of RRT was intermittent hemodialysis (IHD), 47 sessions (49.0% of all RRT sessions), then, continuous renal replacement therapy (CRRT), sustained low-efficiency dialysis (SLED), and acute peritoneal dialysis (PD), at 43 sessions (44.8%), 4 sessions (4.2%), and 2 sessions (2.1%), respectively.

Table 2. Intensive care characteristics of elderly surgical intensive care patients with acute kidney injury versus those without

Variables	All Elderly (n = 2,310)	Elderly with AKI (n = 445)	Elderly without AKI (n = 1,865)	*p*-value
Type of ICU admission				<0.001
Available data	2,223	438	1,785	
Emergency surgery (n (%))	540 (24.3)	165 (37.7)	375 (21.0)	
Elective surgery (n (%))	1,187 (53.4)	119 (27.2)	1,068 (59.8)	
Medical problems[a] (n (%))	496 (22.3)	154 (35.2)	342 (19.2)	
Sources of ICU admission				<0.001
Available data	2,282	441	1,841	
Emergency department (n (%))	202 (8.9)	55 (12.5)	147 (8.0)	
Operating theater/recovery room (n (%))	1,581 (69.3)	226 (51.3)	1,355 (73.6)	
General wards (n (%))	453 (19.9)	147 (33.3)	306 (16.6)	
Others intensive care units* (n (%))	46 (2.0)	13 (3.0)	33 (1.8)	
Priority of ICU admission[#]				<0.001
Available data	2,295	443	1,852	
Priority I (n (%))	546 (23.8)	169 (38.2)	377 (20.4)	
Priority II (n (%))	1,687 (73.5)	248 (56.0)	1,439 (77.7)	
Priority III (n (%))	50 (2.2)	21 (4.7)	29 (1.6)	
Priority IV (n (%))	12 (0.5)	5 (1.1)	7 (0.4)	
American society of Anesthesiologist physical status classification (ASA-status)				<0.001
Available data	1,772	279	1,493	
ASA-I (n (%))	18 (1.0)	1 (0.4)	17 (1.1)	
ASA-II (n (%))	500 (28.2)	46 (16.5)	454 (30.4)	
ASA-III (n (%))	1,039 (58.6)	165 (59.1)	874 (58.5)	
ASA-IV (n (%))	196 (11.1)	58 (20.8)	138 (9.2)	
ASA-V (n (%))	17 (1.0)	9 (3.2)	8 (0.5)	
ASA-VI (n (%))	2 (0.1)	0 (0.0)	2 (0.1)	
Site of operation				0.002
Available data	1,633	274	1,359	
Head, neck and maxillofacial (n (%))	144 (8.8)	12 (4.4)	132 (9.7)	
Abdominal and colorectal (n (%))	1,029 (63.0)	193 (70.4)	836 (61.5)	
Orthopedics[!] (n (%))	306 (18.7)	39 (14.2)	267 (19.7)	
Other types of surgery[$] (n (%))	154 (9.4)	30 (11.0)	124 (9.1)	

[a] Medical admissions were composed of surgical diseases that could be treated with medication alone, without surgery (such as acute cholangitis, acute pancreatitis, sepsis that could be treated with medication alone, etc.); * Other intensive care units included cardiac care unit (CCU) and other types of intensive care unit; [!] Orthopedic surgery included all extremities and spine surgery; [$] Other types of surgery included thoracic, vascular, and gynecologic and obstetric surgery

Discussion

Elderly patients accounted for nearly half of our THAI-SICUs' study participants and one-fifth of them were diagnosed with AKI. Once the elderly had AKI, they usually had higher ICU and 28-day hospital mortality than those without. Moreover, mortality also increased corresponding to AKI severity stages, when compared with non-AKI. Independent risk factors associated with an increased risk of AKI in the elderly admitted to surgical ICU were: robust indices of disease severity (APACHE-II and SOFA score), smoking history, emergency surgery, co-occurrence of ICU diseases (including sepsis, delirium, and myocardial infarction and new onset of arrhythmia), and requiring respiratory support. RRT was done in almost a quarter of AKI; the commonest method was IHD followed by CRRT, SLED and PD, respectively.

There have been some landmark studies of AKI in the ICU, for example, the study by Ostemann et al[1]. They reported AKI prevalence at 35.8% of ICU patients in the United Kingdom with significantly greater ICU and hospital mortality in AKI patients than those without AKI. Moreover, the mortality rate in AKI increased with each stage (hospital mortality of patients who had RIFLE classification at risk, 20.9%; injury, 45.6%; and failure, 56.8%; compared to non-AKI, 8.4%). In addition, OR for hospital death also corresponded with AKI staging (2.11 in the risk category, 5.15 for injury, and 8.27 for failure category). RRT was performed on 12.2% of AKI patients, with CRRT used the most in this study (80.2%). Only 5.2% and 0.7% of AKI patients received IHD and PD, respectively. Factors associated with mortality in AKI, using logistic regression analysis were admission after cardiac surgery and emergency surgery, number of organ failures, APACHE-II score, pre-existing chronic kidney disease, need for mechanical ventilation, and AKI stages.

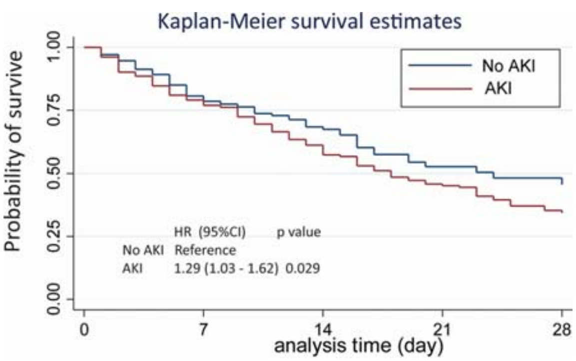

Fig. 1 Kaplan-Meier survival function curves of the probability of the elderly critically ill patients with acute kidney injury compared with non-acute kidney injury.

Another landmark study was reported by Hoste et al[2]. They studied AKI epidemiology in a multicenter in the United States, where over 60% of their patients were surgical-based admissions. AKI occurred within 67% of patients and hospital mortality interm of Risk, Injury, and Failure (by RIFLE-classification) was at 8.8%, 11.4%, and 26.3%, respectively, compared with only 5.5% for patients without AKI. The hazard ratio of hospital mortality in each RIFLE stage was 1.7, 1.4, and 2.7, respectively. RRT from this study was only 4.1%. Moreover, they showed that pre-existing chronic kidney disease, admission due to trauma, gastrointestinal disease, and malignancy, and SOFA score as the covariates most associated with AKI in their ICU.

The last landmark study we selected, was written by Thakar et al[3]. Veterans Affairs ICU patients in the US were studied and over three-fifths (66.4%) of them were aged over 60 years old. The results showed that 22% of all Thakar et al population developed AKI by AKIN criteria (above 65% of AKI were aged over 60). Moreover, patients admitted to surgical ICUs were more prone to AKI (24.6%) than those admitted to medical ICUs (22.6%) and cardiac ICUs (18.7%). The overall ICU mortality was reported as10.9%, with

Table 3. Outcomes of surgical intensive care patients according to elderly and non-elderly acute kidney injury groups

Outcomes	All Elderly (n = 2,310)	Elderly with AKI (n = 445)	Elderly without AKI (n = 1,865)	*p*-value
ICU mortality (n (%))	222 (9.6)	125 (28.1)	97 (5.2)	<0.001
28-day hospital mortality (n (%))	335 (14.5)	159 (35.7)	176 (9.4)	<0.001
ICU length of stay (days)*	2 (1-4)	5 (2-13)	1 (1-3)	<0.001
Hospital length of stay (days)*	15 (9-26)	17 (10-29)	15 (9-25)	0.007
Mechanical ventilator support (n (%))	1,345 (58.2)	383 (86.1)	962 (51.6)	<0.001
Duration of mechanical ventilation (days)*	2 (1-5)	5 (2-13)	2 (1-4)	<0.001
Concurrent morbidity during ICU stay				
Sepsis (n (%))	475 (20.6)	232 (52.1)	243 (13.0)	<0.001
Delirium (n (%))	94 (4.1)	55 (12.4)	39 (2.1)	<0.001
Acute lung injury/acute respiratory distress syndrome (n (%))	117 (5.1)	55 (12.4)	62 (3.3)	<0.001
Myocardial infarction and new onset of arrhythmia (n (%))	236 (10.2)	108 (24.3)	128 (6.9)	<0.001

ICU = intensive care unit
* Reported as median and (interquartile range)

Table 4. Multivariable logistic regression demonstrated factors that predicted acute kidney injury in the elderly

Variables	Crude OR	95% CI	Adjusted OR	95% CI
Age (year-old)	1.020	1.001-1.036	1.021	1.002-1.039
Male	1.470	1.185-1.822	1.260	0.940-1.689
Body mass index (kg/m^2)	0.990	0.697-1.013	-	-
APACHE-II score	1.125	1.107-1.144	1.027	1.004-1.050
SOFA score	1.295	1.254-1.337	1.145	1.097-1.196
Current smoker$	2.045	1.422-2.939	1.601	1.013-2.529
Ex-smoker$	1.437	1.146-1.803	1.348	0.993-1.829
Emergency surgery	2.341	1.873-2.927	1.320	1.010-1.724
Present of pre-existing comorbidities	1.060	0.989-1.137	-	-
Sepsis	7.270	5.778-9.148	2.822	2.148-3.709
Respiratory support	5.799	4.368-7.697	2.164	1.564-2.996
Cardiac complications*	4.349	3.282-5.762	2.167	1.550-3.029
Delirium	6.603	4.318-10.096	2.825	1.686-4.733

* Cardiac complication included myocardial infarction and new onset of cardiac arrhythmia, $ Reference by non smoker
APACHE-II score = Acute Physiology and Chronic Health Evaluation II score; SOFA score = Sequential Organ Failure Assessment score; ASA class = American Society of Anesthesiologists physical status classification; ICU = intensive care unit

OR of death increasing in each AKIN-stage at 2.90, 6.93, and 8.93, respectively. Moreover, the mean hospital length of stay was longer in AKI patients (stage 1:7.0±6.1 days; stage 2: 10.6±8.7 days; stage 3: 14.0±10.0 days) than those without AKI (4.5±3.7 days).

The studies mentioned above investigated all age groups admitted to ICU. Although, the authors did extensive research into AKI, it only specified geriatric critical ill; however, only a few studies were found. Gong et al[16] published information about 189 AKI participants, which included 99 (52.4%) elderly patients. The mortality rate of elderly with AKI in this study was 42.4% and the hospital length of stay was 22.5 (12-51) days (higher mortality rate and longer hospital length of stay than our study), but RRT was performed in only 12.1% of AKI cases (lower rate than our study). When comparing subject disease severity (evaluated by APACHE-II score) between Gong and our study, we found that Gong's patients had greater severity score than our study (17 (13-26), while our study was 12 (8-16)). The average age of patients between these two studies was not much different (77.9±7.9 years old from Gong et al, and 75.8±7.0 years old from our study).

Data about AKI incidence in post-operative elderly patients was reported by Chao et al[20]. They found AKI in 23.1% of their elderly group (age over 65 enrollment criterion). Although, the mortality rate of AKIN-3 was 3.19-times (Cox proportional hazard) over non-AKI, but there were no significant differences in other stages of AKIN compared to non-AKI in this study. An additional study by Shin et al reported mortality rate at 39.8% of elderly (age above 65 years old) who had AKI in the in ICU[21]. However, this study did not demonstrate any statistically significant differences in RIFLE classification between the survivors and non-survivors.

Limitations of this study were, first, changes in serum creatinine level are an unreliable indicator of the onset of AKI in elderly patients. The important factor is a low muscle mass of the elderly, which leads to delayed elevation of serum creatinine when AKI happens. Moreover, other factors also influence raised serum creatinine in the elderly such as the volume of distribution, catabolic stage, and medication interactions in older people[22]. All of these might produce a lower rate than usual of AKI in the elderly. Second, our research had some missing values. These might skew the exact incidence of our prospective cohort result. However, to the best of our capability we tried as hard as we could to find out this information. Third, this study only enrolled elderly patients admitted to surgical ICU; therefore, this study might not represent the characteristics of elderly patients admitted to medical ICU. Finally, recently Kellum et al formulated a new AKI definition after we had started our study: the Kidney Disease Improving Global Outcomes (KDIGO) in 2012[23]. Comparing AKI definitions between AKIN and KDIGO criteria reveals great similarity, the only small difference is in the cut-off-point of an increase in serum creatinine compared to baseline value definition of AKI staging. Therefore, researchers thought that the epidemiology of AKI in elderly ICU will not change much when applying new AKI criteria to our subjects.

Conclusion

As the result of this study, the authors identified AKI in one-fifth of elderly critical ill patients in surgical ICUs in Thailand. Moreover, when older patients had AKI, they usually had higher ICU and hospital mortality than elderly who did not have AKI. This information seems to accord with worldwide studies about AKI. Many potential risk factors for having AKI in elderly admitted to our surgical ICUs were identified. These factors should receive proper attention with the hope of preventing new onset of AKI and reducing mortality in elderly patients.

What is already known about this topic?

Acute kidney injury (AKI) is a rapid decline in kidney function leading to dysregulation in fluids, electrolytes, and metabolic waste products. The occurrence of AKI is often 22-67% in the intensive care unit (ICU) (variety of AKI definitions had been applied). Advanced age is one of the potential risk factors for developing this problem.

What this study adds?

Analysis of large data from elderly patients in surgical ICU shows that nearly one-fifth of them developed AKI. Once they had AKI, ICU mortality and 28-day hospital mortality were higher than those without AKI. The results further demonstrate that high severity scores and coexisting diseases are important risk factors for developing AKI.

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The THAI-SICU study group is listed below

Suneerat Kongsayreepong, Onuma Chaiwat (Siriraj Hospital, Mahidol University, Bangkok), Kaweesak Chittawatanarat, Tanyong Pipanmekaporn (Chiang Mai University, Chiang Mai) Sunthiiti Morakul (Ramathibodi Hospital, Mahidol University, Bangkok), Thammasak Thawitsri, Somrat Charuluxananan (King Chulalongkorn Memorial hospital, Chulalongkorn University, Bangkok), Petch Wacharasint, Pusit Fuengfoo (Phramongkutklao Hospital, Bangkok), Sunisa Chatmongkolchart, Osaree Akaraborworn (Prince of Songkla University, Songkhla), Chompunoot Pathonsamit, Sujaree Poopipatpab (Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok), Sarinya Chanthawong, Waraporn Chau-In (Khon Kaen University, Khon Kaen), Chaiyapruk Kusumaphanyo, Phakapan Buppha (Srinakharinwirot University, Bangkok).

Potential conflicts of interest

None.

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ภาวะไตบาดเจ็บเฉียบพลันของผู้ป่วยสูงอายุในหออภิบาลผู้ป่วยทางศัลยกรรมสหสถาบัน

กลวิชย์ ตรองตระกูล, สุจารีย์ ภู่พิพัฒน์ภาพ, ชวิกา พิสิฏฐศักดิ์, กวีศักดิ์ จิตตวัฒนรัตน์, สัณฐิติ โมรากุล, กลุ่มศึกษา THAI-SICU

วัตถุประสงค์: *เพื่อศึกษาอุบัติการณ์คุณลักษณะและผลลัพธ์ที่เกิดขึ้นในผู้ป่วยสูงอายุที่เกิดภาวะไตบาดเจ็บเฉียบพลันในหออภิบาลผู้ป่วยทางศัลยกรรมสหสถาบันของประเทศไทย*

วัสดุและวิธีการ: *รวบรวมและวิเคราะห์ข้อมูลผู้ป่วยสูงอายุที่มีภาวะไตบาดเจ็บเฉียบพลันจาก การศึกษาสหสถาบันจากการเก็บข้อมูลไปข้างหน้าในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรมของคณะแพทยศาสตร์ 9 แห่งในประเทศไทย ข้อมูลเก็บตั้งแต่ เดือนเมษายน พ.ศ. 2554 ถึง เดือนมกราคม พ.ศ. 2556 การวิเคราะห์ทางสถิติประกอบด้วยการเปรียบเทียบข้อมูลพื้นฐาน คุณลักษณะและผลลัพธ์ในกลุ่มผู้ป่วยสูงอายุที่มีภาวะไตบาดเจ็บเฉียบพลันเทียบกับกลุ่มที่ไม่เกิดภาวะนี้ โดยนิยามผู้ป่วยสูงอายุคือ ผู้ป่วยที่มีอายุมากกว่าหรือเท่ากับ 65 ปีขึ้นไป*

ผลการศึกษา: *มีจำนวนผู้ป่วยสูงอายุที่รักษาในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรมจำนวน 2,310 ราย (ร้อยละ 49.7) จากผู้ป่วยที่เข้ารับการรักษาในหออภิบาลฯ ทั้งหมด 4,652 ราย พบผู้ป่วยสูงอายุเกิดภาวะไตบาดเจ็บเฉียบพลันจำนวน 445 ราย (ร้อยละ 19.3 ของผู้สูงอายุทั้งหมด) ความแตกต่างระหว่างคุณลักษณะพื้นฐานของผู้ป่วยสูงอายุที่เกิดภาวะไตบาดเจ็บเฉียบพลันเมื่อเปรียบเทียบกับผู้สูงอายุที่ไม่เกิดภาวะไตบาดเจ็บเฉียลพลัน ได้แก่ อายุ, เพศชาย, การสูบบุหรี่ และความรุนแรงของโรคเมื่อประเมินด้วย APACHE-II และ SOFA score นอกจากนี้อัตราการเสียชีวิตของผู้ป่วยสูงอายุที่มีภาวะไตบาดเจ็บเฉียบพลันในหออภิบาลฯ สูงกว่ากลุ่มที่ไม่มีภาวะนี้อย่างมีนัยสำคัญทางสถิติ (ร้อยละ 28.1 vs. 5.2, p<0.001 โดยมีอัตราเสี่ยงเป็น 5.401 เท่า (95% CI 4.231-6.895) เช่นเดียวกับอัตราการเสียชีวิตในโรงพยาบาล (ร้อยละ 35.7 vs. 9.4, p<0.001; อัตราเสี่ยง 3.786 เท่า (95% CI 3.138-4.569)) เมื่อวิเคราะห์โดยควบคุมอิทธิพลด้วยสัมประสิทธิ์ถดถอยโลจิสติคเชิงพหุ พบว่าปัจจัยที่ส่งผลต่อการเกิดภาวะไตบาดเจ็บเฉียบพลันในกลุ่มผู้ป่วยสูงอายุได้แก่ อายุ, ความรุนแรงของโรคเมื่อประเมินด้วย APACHE-II และ SOFA score, การสูบบุหรี่, การได้รับผ่าตัดฉุกเฉิน, ภาวะติดเชื้อในกระแสโลหิต, ภาวะแทรกซ้อนระบบหัวใจ, ภาวะเพ้อ, และการใช้เครื่องพยุงการหายใจขณะเข้ารับการรักษาหออภิบาลฯ*

สรุป: *ผลการศึกษาพบผู้ป่วยสูงอายุมากกว่าครึ่งหนึ่งของผู้ป่วยที่การเข้ารับการรักษาในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรม และเกือบ 1 ใน 5 ของผู้ป่วยกลุ่มนี้พบว่าเกิดภาวะไตบาดเจ็บเฉียบพลัน โดยภาวะดังกล่าวส่งผลต่อการเพิ่มขึ้นของอัตราเสียชีวิตในหออภิบาลผู้ป่วยภาวะวิกฤตทางศัลยกรรมและอัตราการเสียชีวิตในโรงพยาบาล*