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PREVALENCE, RISK FACTORS AND OUTCOMES OF ACUTE KIDNEY INJURY IN PATIENTS WITH BURN. A META-ANALYSIS STUDY

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Abstract:

***Aim of study**: Acute kidney injury (AKI) is a fatal complication of burn injury. The aim of the study is to determining the prevalence, risk factors, and outcomes of AKI in patients with burn injury.*

***Method**: An electronic search (up to 2017) was performed using Pubmed, Embase, Medline, Web of Knowledge, and the Cochrane Library databases. Finally, a total of 18 articles (nine prospective cohort, seven retrospective cohort, two case–control) met the inclusion criteria.*

***Results:** The pooled incidence of AKI was 39.6% (95% confidence interval = 34.7–44.4%). Important risk factors for the occurrence of AKI included age (OR = 3.78 1.28–6.27), TBSA (OR = 15.66 [11.01–20.31]), full-thickness TBSA (OR = 15.66 [11.01–20.31]), flame burn (OR = 1.56 [1.09–2.25]), inhalation injury (OR = 2.97 [1.80–4.89]), abbreviated burn severity index on admission (OR = 2.42 [1.87–2.98]), sequential organ failure assessment score on admission baseline blood urea nitrogen (OR = 2.11 [0.72–3.51]), serum creatinine (OR = 2.69 [1.39–3.98]), and sepsis (OR = 4.42 [1.75–11.18]). Additionally burn patients with AKI are more likely to have long stay in intensive care unit and high mortality rate.*

***Conclusion:** AKI is a common complication and occurs at a remarkable rate in burn patients. 10 independently variables as risk factors for the development of AKI in burn patients were identified.*

Key words: *Acute kidney injury Burns Thermal injury Meta-analysis Mortality.*

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INTRODUCTION:

Acute kidney injury (AKI) is a fatal complication of burn injury, which is associated with increased mortality rate, increased hospital stay, and highest cost. The incidence of AKI in burn patients ranged from <1 to 64% is documented in different literature and mortality ranged from 28 to 100%. [1-3] due to the absence of a gold standard criterion for diagnosing AKI incidence ranged widely. [4] In addition, To find out the solution for this problem and establish a uniform definition for AKI, Acute Dialysis Quality Initiative developed and proposed the Risk, Injury, Failure, Loss of function, End-stage renal disease (RIFLE) (fig 1) criteria in 2004. [5]

Older age, severity of the burn injury assessed by the total burned surface area (TBSA) fig 2, sepsis and multiorgan dysfunction are well-recognized risk factors for the development of AKI in burn patients. [6-8] factors that contributed for the development of AKI are reduced renal perfusion and inflammation. Renal ischemia is probably not important in the acute phase of burn injury than originally presumed [9]. Instead, inflammation and apoptosis are probably playing an important role. Excessive volume resuscitation to prevent and treat burn shock cause to intra-abdominal hypertension and abdominal compartment syndrome, which is an underestimated contributing factor to the development of late AKI after burn shock [10]. The intensity and duration of inflammatory phases is an important difference between major burn trauma patients and other types of ICU patients, which may last longer in burn patients. [11]

As is fact, prevention of disease onset and its progression can be slowed down by greater understanding of risk factors for an illness, However, many studies are limited by their definition of AKI, single-center study, small sample size, and examination of a single or a few variables. Moreover, the findings on risk factors for AKI in previous had many variations and contradictions. The aim of this study is to find out prevalence, risk factors and outcomes of the AKI in burn patients defined by RIFLE criteria.(fig 1).

Fig 1: RIFLE Criteria for acute kidney injury

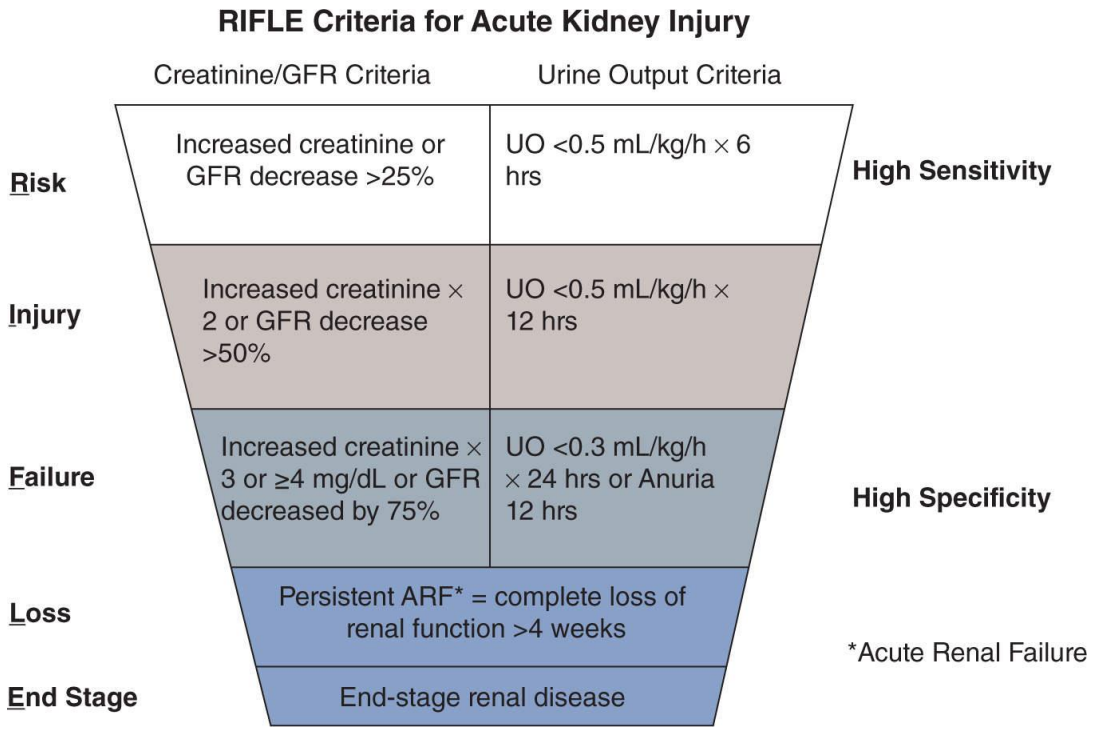
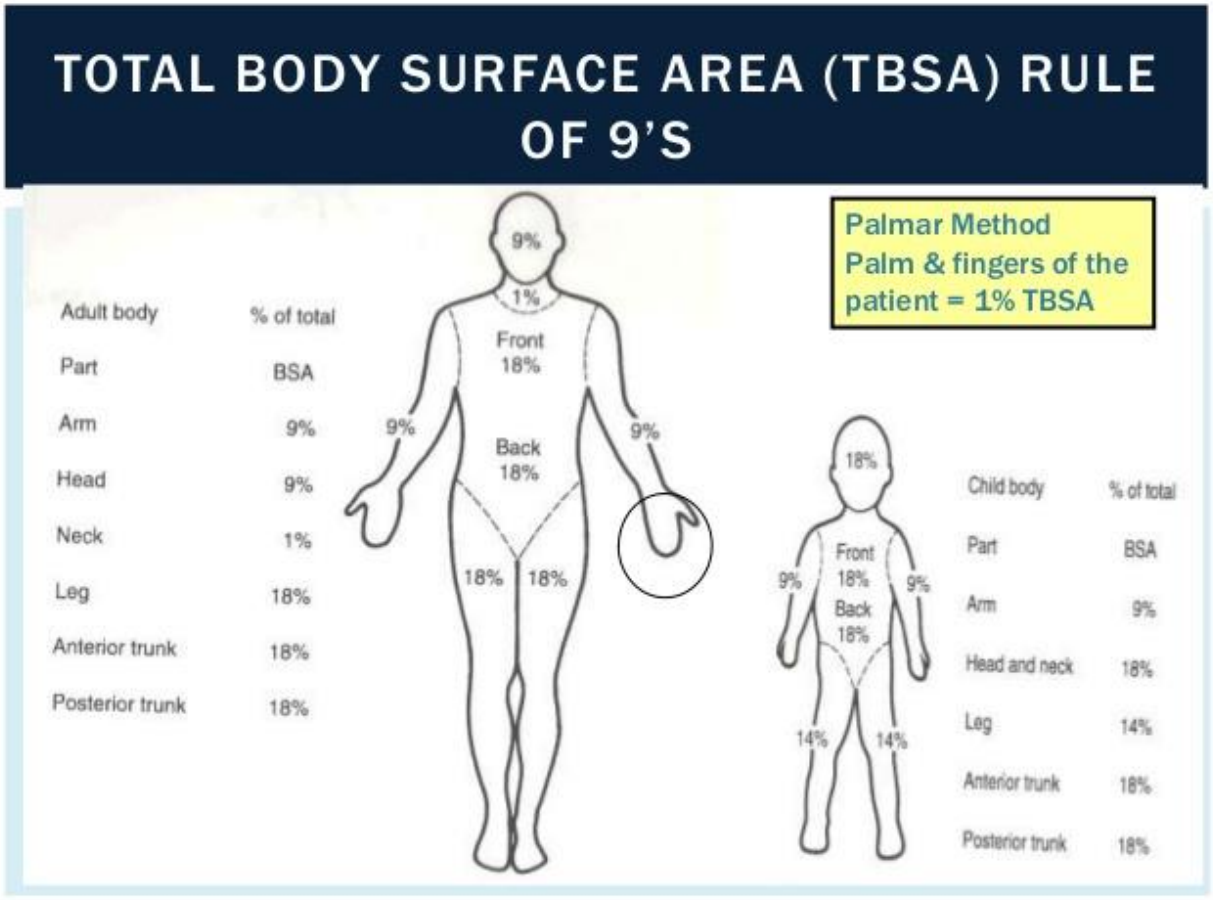


Fig 2: Total burned surface area



METHOD:

Search Strategy:

Electronic literature searches of PubMed, Embase, Medline Web of Knowledge, and the Cochrane Library databases up to 2017. The search Mesh terms were used as follows: "acute kidney injury" and "burn". Reference lists of published articles were also hand-searched for additional relevant studies.

Inclusion Criteria:

Only those studies were selected that meet the inclusion criteria i.e. 1) all the participant who admitted to hospital with burn injury; 2) only RIFLE criteria based definition and diagnosis were used for AKI ; 3) provide one or more index for the incidence, risk factors, or outcomes of AKI.

Exclusion criteria:

A study was excluded if it was duplicated or did not fulfill inclusion criteria mentioned above. Reviews and case reports were also excluded.

Data Extraction:

The final data were extracted from the selected studies first author, year of publication, study design, definition of AKI, study population, number of patients with or without AKI, risk factors, and indexes representing clinical outcomes.

Quality Assessment

quality of the studies included in this review using the Newcastle–Ottawa Scald,[12] which allocates a maximum of nine points for quality of the selection (four items, four points), comparability (one item, two points), and outcome or exposure (three items, three points).

Statistical Analysis

A descriptive data was performed to characterized patient basic information, as well as the prevalence and causes of AKI in burn patients, and a meta-analysis was conducted to summarize the risk factors and outcomes with Review Manager 5.1 and Stata 11.0. For continuous variables, the weighted mean difference and 95% confidence intervals (CIs) were calculated. For categorical variables, odds ratio (OR) and 95% CIs were used. Heterogeneity across included studies was assessed using the I2 index and the Q test P value, and was considered significant if P < .1 or I2 > 50%.

RESULT AND DISCUSSION:

A total of 1649 relevant articles were retrieved from Pubmed , Embase , Web of Knowledge, the Cochrane Library databases.After combining and removing duplicates, 997 studies remained. Based on titles and abstracts, 936 were further excluded. The remaining 61 articles were subsequently screened in full text. Thirty-four studies were excluded because they did not use RIFLE criteria to diagnose AKI. No risk factors for AKI could be extracted in seven articles. In addition, there was one letter, and one study with no comparison group. Finally, 18 articles were included in the meta-analysis. The details of selection are shown in Figure 3 and table 1.

Fig 3: study selection

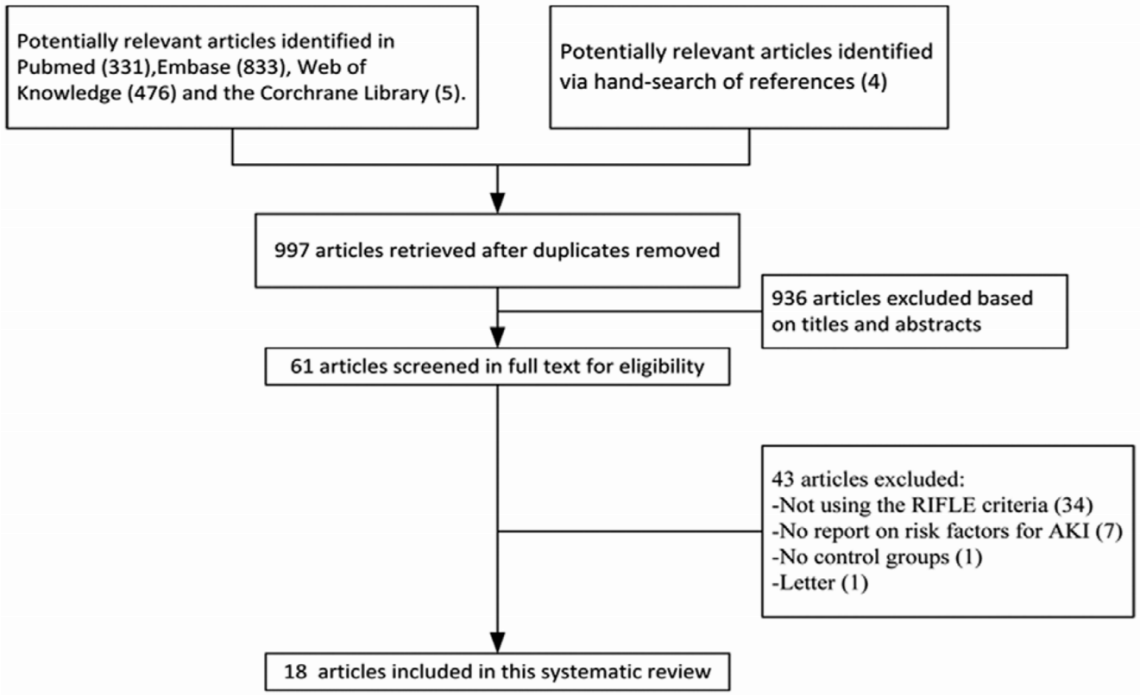


Table 1. Basic characteristics of the included studies

Coca et al (2007)[20]	304 (81/223)	45 ± 18	40 ± 16	55	182	Retrospective cohort
	127 (31/96)	55.1 (47.4–62.7)	35.9 (31.8–40.1)	21	74	Prospective, cohort
Steinvall et al (2008)[26]	29 (19/10)	50.4 ± 4.6	55.5 ± 6	12	8	Prospective, case–control
	40 (9/31)	44.67 ± 18.03	34.84 ± 9.17	4	13	
Mariano et al (2008)[36] Sabry et al (2009)[9]	123 (56/67)	6.74 ± 5.4	7.4 ± 5.4	33	47	Prospective, cohort
	60 (32/28)	46 ± 14	41.9 ± 16	26	23	Retrospective cohort
Palmieri et al (2009)[37]	221 (62/159)	50.8 ± 18.3	39.1 ± 14	43	118	Retrospective cohort
	221 (104/117)	47.23 ± 17.06	38.07 ± 14.02	78	83	Retrospective cohort
Palmieri et al (2010)[4]	973 (656/1317)	33 (24–500)	30 (22–44)	86	86	Retrospective cohort
	396 (151/245)	41 ± 16	39.5 ± 16.91	120	178	Retrospective cohort
Mosier et al (2010)[16]	45 (11/34)	53.9 ± 13.1	49.1 ± 13.5	9	26	Retrospective cohort
	85 (48/37)	51.9 ± 14.5	46.2 ± 15.2	42	30	Prospective, cohort
Schneider et al (2012)[6]	90 (55/35)	51.82 ± 14.11	45.4 ± 14.8 2 (1–6)	48	29	Prospective, cohort
	22 (6/16)	4 (2–6)		5	7	Prospective, cohort
Chung et al (2012)[38] 1	97 (40/57)	48.7 ± 16.4	45.9 ± 13.8	36	42	Prospective, case–control
	59 (23/36)	37.26 ± 8.97	37.39 ± 11.6	-		
Hu et al (2012)[19] Hong et al (2013)[10]	30 (14/16)	40.46 ± 16.5	41.3 ± 15	-		Prospective, cohort
	19 (9/10)	59.7 ± 12.4	48.2 ± 18.8	6	5	Prospective, cohort
Kym et al (2015)[11]						Prospective, cohort
						Prospective, cohort
Yang et al (2014)[5]						
Yavuz et al (2014)[31] Yim et al (2015)[18]						
Liang et al (2015)[12]						
Sen et al (2015)[17]						
Rakkolainen and Vuola (2016)[13]						

AKI, acute kidney injury.

Prevalence of AKI:

The pooled incidence of AKI was 39.6% (95% confidence interval = 34.7–44.4%). And the all the range of prevalence seen in table 2.

Tabl 2: prevalence AKI according to RIFLE criteria

Subgroup	Studies	Patients	Patients With AKI (n)	AKI Incidence Rate (%) (95% CI)	I^2 Index (%)	*P*
All	18	3941	1407	39.6 (34.7–44.4)	85.5	<.01
Prospective	9	592	240	40.1 (29.7–50.5)	85.9	<.01
Retrospective	7	3298	1142	37.6 (32.0–43.1)	87.0	<.01
Case–control	2	51	25	46.6 (9.1–84.0)	88.5	<.01

AKI, acute kidney injury; CI, confidence interval.

Risk Factors
Seventeen potential risk factors (reported in at least three studies) are summarized in the present meta-analysis. Forest plots for potential risk factors predisposing to AKI are shown in Figure 4.

Age:
Fifteen studies including 4786 patients indicated that there was a significant association between age and the occurrence of AKI in burn patients (random effect model, I2 = 77%; OR = 3.78, 95% CI = 1.28–6.27, P < .01; Figure 4A).

Sex:
When the 16 studies in which the authors reported gender were aggregated, sex was not associated with the occurrence of AKI in burn patients (fixed effect model, I2 = 29%; OR = 1.00, 95% CI = 0.98–1.19, P > .05; Figure 4B).

TBSA:
Fifteen studies including 1819 patients indicated that AKI was more likely to occur in patients with larger burn area (random effect model, I2 = 85%; OR = 15.66, 95% CI = 11.01–20.31, P < .01; Figure 2C).

Pathogenesis:
Ten studies including 716 patients indicated that flame burn was a risk factor for AKI in patients with burn injury (fixed effect model, I2 = 31%; OR = 1.56, 95% CI = 1.09–2.25, P < .05; Figure 2E). Four studies including 571 patients indicated that AKI was less likely to occur in patients with chemical burn (fixed effect model, I2 = 0%; OR = 0.34, 95% CI = 0.18–0.62, P < .01; Figure 2F). There was no association between scald burn or electrical burn and the occurrence of AKI (fixed effect model; OR = 0.76, 95% CI = 0.42–1.36, and OR = 0.92, 95% CI = 0.52– 1.61, respectively, P > .05; Figure 4G, H).

Inhalation Injury:
Twelve studies with a total of 3633 patients indicated that AKI was more likely to occur in burn patients with inhalation injury.

Sequential Organ Failure Assessment Score:
Four studies including 223 patients indicated that AKI was more likely to occur in burn patients with higher SOFA score on admission

Body Mass Index:
Four studies with a total of 299 patients indicated that there was no association between body mass index (BMI) and the occurrence of AKI in burn patients

Mean Arterial Pressure:
Four studies including 310 patients indicated that there was no association between mean arterial pressure (MAP) and the occurrence of AKI in burn patients

Urine Output:
Three studies with a total of 310 patients indicated that there was no association between urine output at first 24 hours and the occurrence of AKI in burn patients (random effect model, I2 = 97%; OR = −0.23, 95% CI = −0.69 to 0.23, P > .05)

Blood Urea Nitrogen:
Three studies including 155 patients indicated that AKI was more likely to occur in burn patients with higher worst blood urea nitrogen (BUN) at first day post injury (fixed effect model, I2 = 35%; OR = 2.11, 95% CI = 0.72–3.51, P < .01; Figure 3P).

Serum Creatinine:
Eight studies including 881 patients indicated that AKI was less likely to occur in burn patients with higher baseline serum creatinine at first day post injury

Sepsis:
Three studies with a total of 310 patients indicated that patients with sepsis were more likely to develop AKI (random effect model, I2 = 71%; OR = 4.42, 95% CI = 1.75–11.18, P < .01;

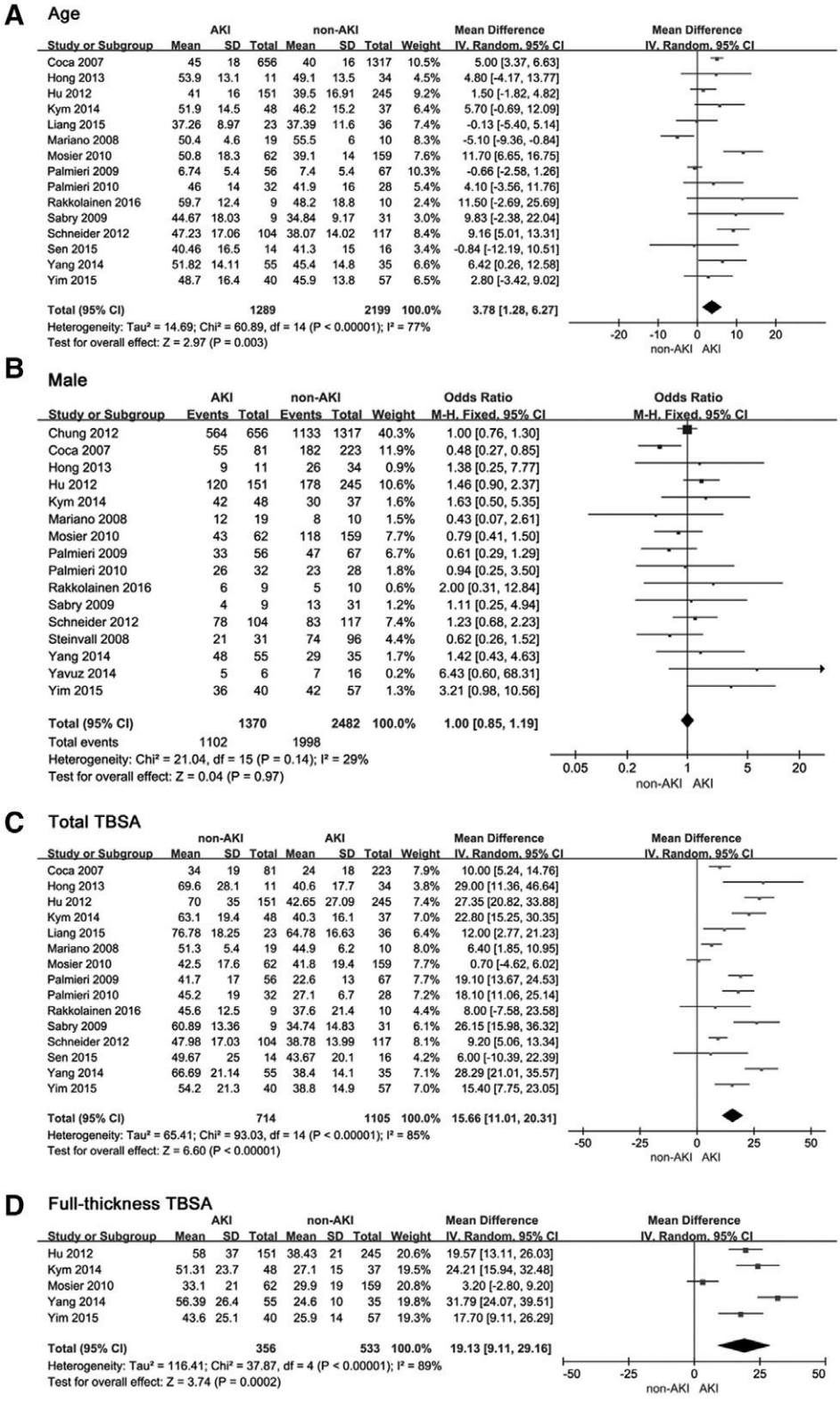
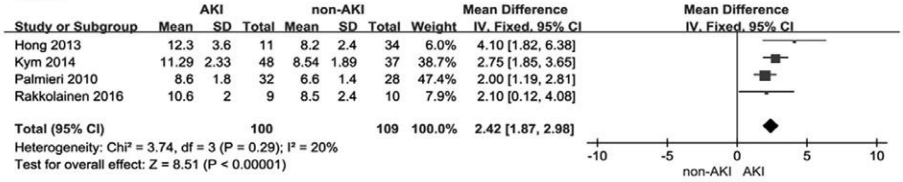
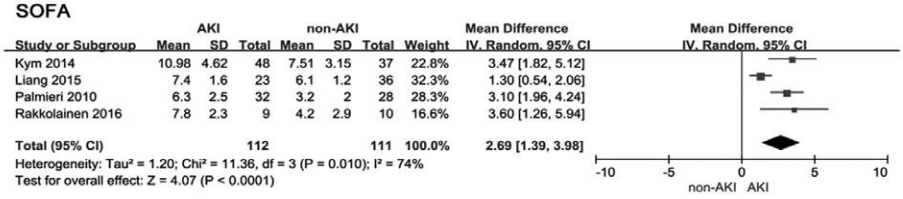


Figure 2. Forest plots for significant risk factors for acute kidney injury with data available in at least three studies. Squares: odds ratios or weighted mean differences; horizontal lines: 95% CIs; diamonds: pooled odds ratios. CI, confidence interval.

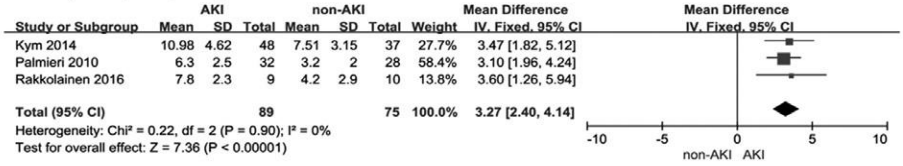
J ABSI



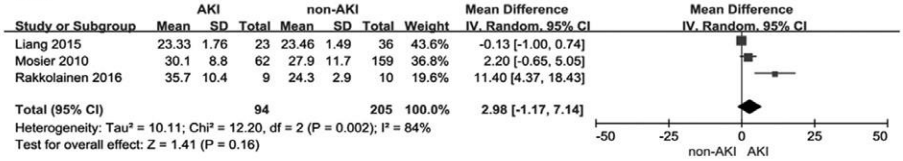
K SOFA



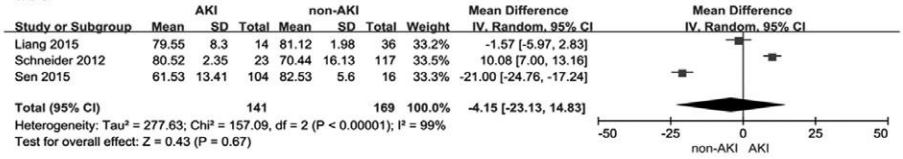
L SOFA (omitting Liang 2015)



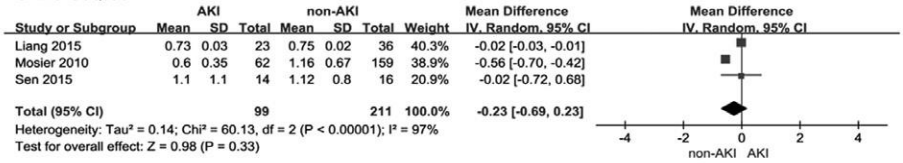
M BMI



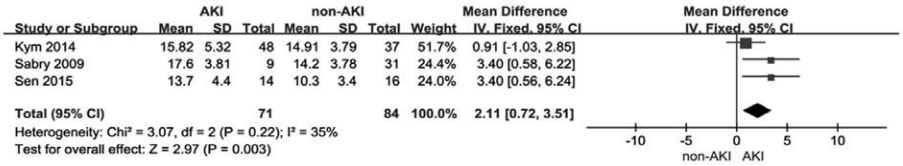
N MAP



O Urine output



P BUN



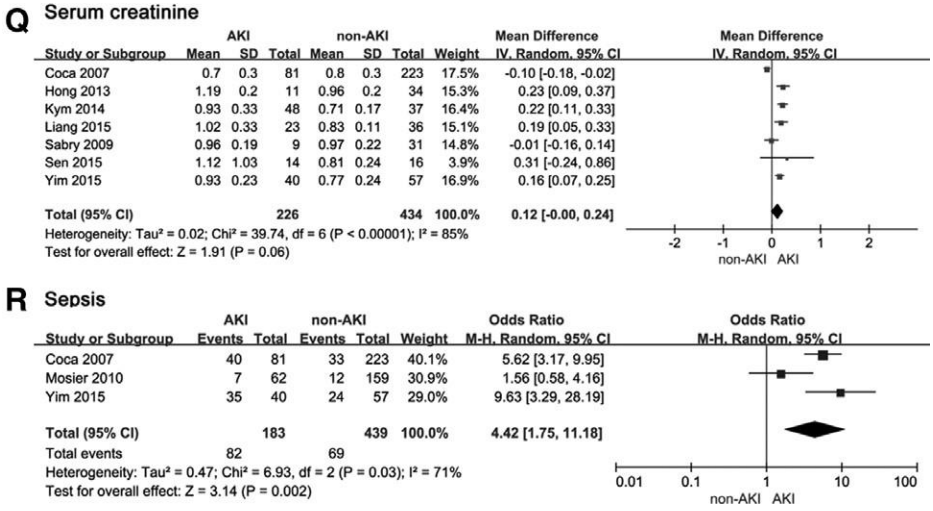


Fig:4 Risk Factors

Clinical Outcomes:

ICU Length:

When the data from six studies with total 772 patients that reported on intensive care unit (ICU) length were aggregated, we found burn patients developed AKI were associated with longer ICU stay (random effect model, I2 = 70%; OR = 13.25, 95% CI = 5.85–20.64, P < .01; fig 5

ICU Mortality. Three studies including 579 patients indicated that patients with AKI have significantly greater ICU mortality (fixed effect model, I2 = 0%; OR = 6.63, 95% CI = 3.73–11.80, P < .01; Figure 5B).

Length of Stay. When we aggregated seven studies that reported on length of stay (LOS), we found that burn patients with AKI were not associated with increase in LOS fig 5

Mortality. Eleven studies with a total of 3211 patients indicated that mortality was increased significantly in patients with AKI (random effect model; OR = 9.04, 95% CI = 4.43–18.43, P < .01; fig 5

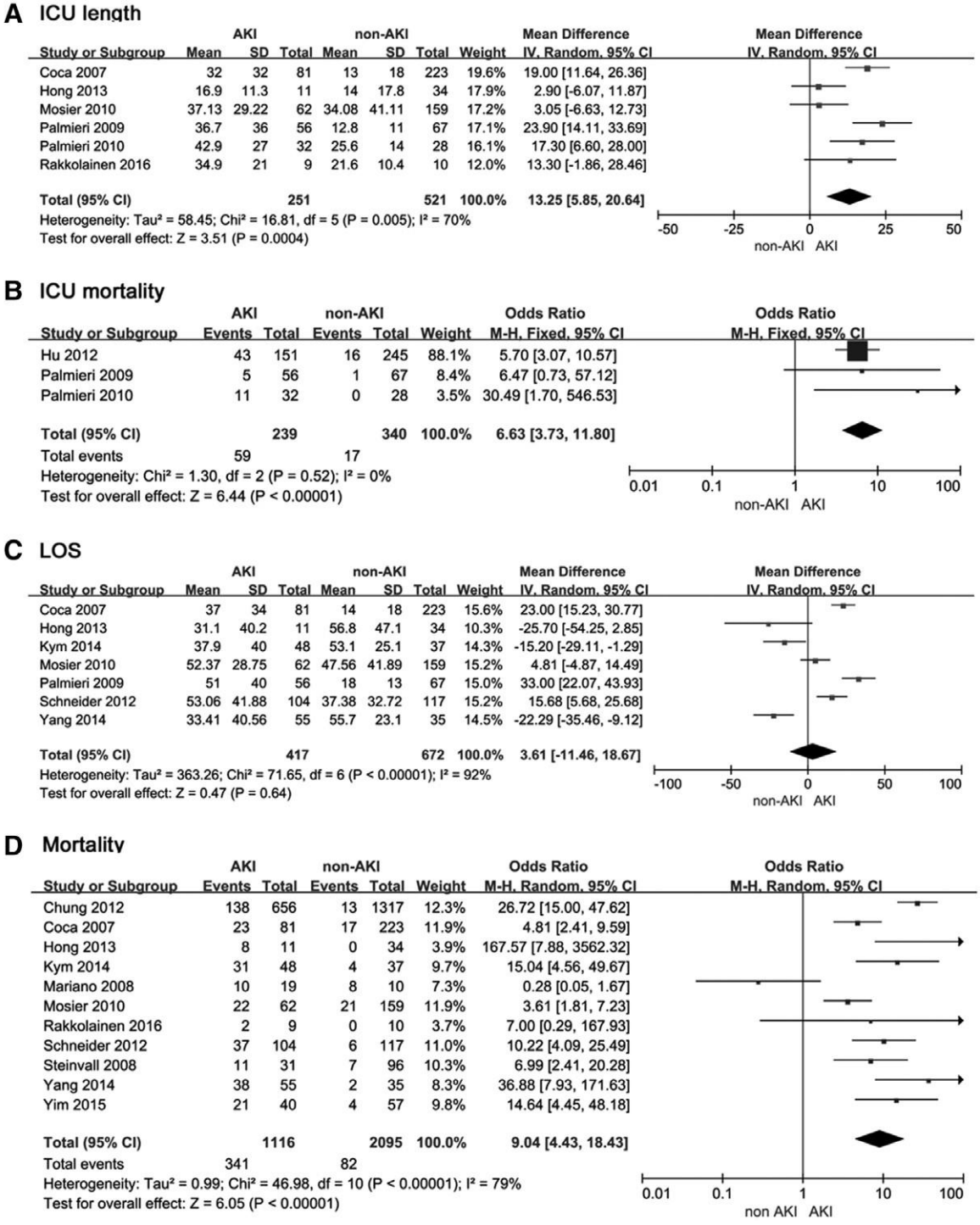


Fig 5: Clinical Outcomes

CONCLUSION:

AKI is frequent complication and occurs at a remarkable rate in burn patients; and AKI is associated with long ICU stay and high mortality. Age, total burn TBSA, full-thickness TBSA, flame burn, inhalation injury, ABSI at admission, SOFA at admission, baseline BUN, baseline serum creatinine, and sepsis are proven risk factors for AKI in burn patients. Our findings may help clinicians to develop effective preventive and therapeutic strategies and provide appropriate, timely initial treatment.

REFERENCE:

1. Mustonen KM, Vuola J. Acute renal failure in intensive care burn patients (ARF in burn patients). J Burn Care Res 2008;29:227–37.
2. Palmieri T, Lavrentieva A, Greenhalgh DG. Acute kidney injury in critically ill burn patients. Risk factors, progression and impact on mortality. Burns 2010;36:205–11.
3. Yang HT, Yim H, Cho YS, et al. Assessment of biochemical markers in the early post-burn period for predicting acute kidney injury and mortality in patients with major burn injury: comparison of serum creatinine, serum cystatin-C, plasma and urine neutrophil gelatinase-associated lipocalin. Crit Care 2014;18:R151.
4. Schneider DF, Dobrowolsky A, Shakir IA, Sinacore JM, Mosier MJ, Gamelli RL. Predicting acute kidney injury among burn patients in the 21st century: a classification and regression tree analysis. J Burn Care Res 2012;33:242–51.
5. Bellomo R, Ronco C, Kellum JA, Mehta RL, Palevsky P; Acute Dialysis Quality Initiative workgroup. Acute renal failure - definition, outcome measures, animal models, fluid therapy and information technology needs: the Second International Consensus Conference of the Acute Dialysis Quality Initiative (ADQI) Group. Crit Care 2004;8:R204–12.
6. Fitzwater J, Purdue GF, Hunt JL, O'Keefe GE (2003) The risk factors and time course of sepsis and organ dysfunction after burn trauma. J Trauma 54:959–966 8.
7. Blot S (2009) Development and validation of a model for prediction of mortality in patients with acute burn injury. Br J Surg 96:111–117 9.
8. Colpaert K, Hoste EA (2008) Acute kidney injury in burns: a story of volume and inflammation. Crit Care 12:192
9. Langenberg C, Wan L, Egi M, May CN, Bellomo R (2006) Renal blood flow in experimental septic acute renal failure. Kidney Int 69:1996–2002
10. Tuggle D, Skinner S, Garza J, Vandijck D, Blot S (2007) The abdominal compartment syndrome in patients with burn injury. Acta Clin Belg Suppl 1:136–140
11. Jeschke MG, Mlcak RP, Finnerty CC, Norbury WB, Gauglitz GG, Kulp GA, Herndon DN (2007) Burn size determines the inflammatory and hypermetabolic response. Crit Care 11:R90.