



A COMPARISON OF AKIN AND RIFLE CRITERIA FOR PROGNOSIS IN ACUTE KIDNEY INJURY – A CASE SERIES STUDY

General Medicine

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ABSTRACT

Introduction: Acute renal failure is associated with high mortality and it also has effect on the risk of death (1). Acute kidney injury is generally defined as 'an abrupt and sustained decrease in kidney function

Objectives:

1. To find out the mortality and morbidity associated with AKI in hospitalized patients
2. To assess the outcome of AKI with requirement of haemodialysis (HD)
3. To assess the ability of RIFLE AND AKIN classification to prognosticate AKI.

Methods: A total of 65 patients over a period of 18 months with an absolute increase in serum creatinine >0.3 mg/dl ($26.4 > 4 \mu\text{mol/l}$) or a percentage increase in serum creatinine $\geq 50\%$ (1.5-fold from baseline) or a reduction in urine output (documented oliguria < 0.5 ml/kg/hour for > 6 hours)

Results: The study group contains 65 patients (37 males and 28 females). The most common etiology was sepsis followed by urinary tract infection. Diabetes was one of the common comorbidity present in our study. 10 patients required mechanical ventilator. In our present study 21 patients required haemodialysis and 44 patient was conservatively managed. Among these many patients four patient died during our study period. In our present study AKIN criteria allowed the identification of more patients as having acute kidney injury and detecting early requirement of haemodialysis

Conclusion: In our study AKIN is a better predictor for assessing the need of hemodialysis compared to RIFLE criteria.

KEYWORDS

AKI, RIFLE, AKIN, Haemodialysis

INTRODUCTION

In critical ill patient one of main complication is acute renal failure, it is associated with high mortality and it also has effect on the risk of death (1). Acute kidney injury is generally defined as 'an abrupt and sustained decrease in kidney function (2). Risk, Injury, Failure, Loss and End-stage Kidney (RIFLE) classification was formulated by Acute Dialysis Quality Initiative. In this three grades of increasing severity which includes – risk (class R), injury (class I) and failure (class F) and it includes two outcome classes also – loss of kidney function and end stage kidney disease. RIFLE provides three grades of severity for acute kidney injury which is based on change in serum creatinine or change in urine output from baseline condition this is a unique feature of RIFLE classification (2). Acute Kidney Injury Network AKIN proposed a recent classification for AKI. This differs from RIFLE classification by – it reduces the need for baseline creatinine but it requires at least two creatinine values within 48 hours (3). ADQI and representatives from ASN, ISN and NKF and European Society of Intensive Care Medicine in Vicenza, Italy in September 2004 proposed the term Acute Kidney Injury (AKI) which recognize an acute decline in kidney function is often secondary to an injury that causes functional or structural changes in kidneys (4).

SOURCE OF DATA

- This is a one year study from December 1st 2016 to Nov 30th 2017 of patients in Hanagal Shri Kumareshwar Hospital and Research Centre, S.Nijalingappa Medical College, Bagalkot.
- Patient admitted in HSK Hospital
- Patient will be followed till the patient stays in hospital.
- Purpose of the study will be carefully explained to the patients and consent will be taken. Institutional Ethical Committee Clearance will be taken.

INCLUSION CRITERIA FOR THE STUDY GROUP:

Patient with an absolute increase in serum creatinine >0.3 mg/dl ($26.4 > 4 \mu\text{mol/l}$) or a percentage increase in serum creatinine $\geq 50\%$ (1.5-fold from baseline) or a reduction in urine output (documented oliguria < 0.5 ml/kg/hour for > 6 hours)

EXCLUSION CRITERIA FOR THE STUDY GROUP:

- 1) All patients with age < 18 ,

- 2) End-stage renal disease (ESRD) on dialysis,
- 3) Transplanted kidney patients.

RESULTS

In our study maximum number of patient was belong to age group of 60-70 in this we have 20 [30.8%] patients and least in age group of more than 80 years In our present study we have 28 females [43.1%] and 37 males [56.9%] patients.

PRESENCE OF COMORBIDITY

Diabetes is the most common co morbidity associated with most of the patients which include 17 [26.1%] after that is hypertension which include 10 [15.3%] 15 patients in our study population required vasopressor. Among this all the patient required Noradrenalin 15 [23.07%], 3 patient required both noradrenalin and dopamine Among 65 patients, 10 [15.4%] patients required ventilator support during our study period In four patients we observed urinary cast. In this two patient had granular cast and two patients had WBS cast. We observed creatinine for 10 days. In day 1 – 0.7 mg/dl was the minimum value and 9.8 mg/dl was the maximum value, with a mean of 2.90 mg/dl. In day 2- 1.2 mg/dl was the minimum value and 10.1 was the maximum value with mean of 3.31 mg/dl. In day 03- 1.0 mg/dl was the minimum value and 9.5 mg/dl was the maximum value with mean of 3.31 mg/d. In day 4- 0.8 mg/dl was the minimum value and 8.9 mg/dl was the maximum value with mean of 3.23 mg/dl. In day 5- 1.0 mg/dl was the minimum value and 8.9 mg/dl was the maximum value with mean of 3.09 mg/dl. In day 6- 0.8 mg/dl was the minimum value and 8.5 mg/dl was the maximum value with mean of 3.07 mg/dl. In day 7- 0.7 mg/dl was the minimum value and 7.9 mg/dl was the maximum value with mean of 3.11 mg/dl. In day 8- 1.2 mg/dl was the minimum value and 7.4 mg/dl was the maximum value with mean of 3.47 mg/dl. In day 9- 1.4 mg/dl was the minimum value and 8.3 mg/dl was the maximum value with mean of 3.79 mg/dl. In day 10- 0.7 mg/dl was the minimum value and 7 mg/dl was the maximum value with mean of 3.34 mg/dl.

In our study the most common electrolyte abnormality was hyponatremia, 23 [35.28%] patients had hyponatremia. The second most common electrolyte abnormality is hyperkalaemia, which is observed in [13.8%] our study.

Metabolic Acidosis is the common finding in our study population. Among 65 patients, 52 [80%] had metabolic acidosis

Akin Staging For Aki

Rifle Classification For Aki

AKIN stage Day-2	Frequency	%	RIFLE stage Day-2	Frequency	%
1.0	47	72.3	F	14	21.5
2.0	4	6.2	I	4	6.2
3.0	14	21.5	R	47	72.3
Total	65	100.0	Total	65	100.0
AKIN stage Day-3	Frequency	%	RIFLE stage Day-3	Frequency	%
1.0	48	73.8	F	10	15.4
2.0	7	10.8	I	7	10.8
3.0	10	15.4	R	48	73.8
Total	65	100.0	Total	65	100.0
AKIN stage Day-4	Frequency	%	RIFLE stage Day-4	Frequency	%
1.0	47	77	F	9	14.7
2.0	5	8.2	I	4	6.6
3.0	9	14.8	R	48	78.7
Total	61	100.0	Total	61	100.0
AKIN stage Day-5	Frequency	%	RIFLE stage Day-5	Frequency	%
1.0	40	76.9	F	11	21.1
2.0	1	1.9	I	41	78.9
3.0	11	21.2	R	52	100.0
Total	52	100.0	Total	52	100.0
AKIN stage Day-6	Frequency	%	RIFLE stage Day-6	Frequency	%
1.0	28	66.7	F	9	21.4
2.0	5	11.9	I	4	9.5
3.0	9	21.4	R	29	69.1
Total	42	100.0	Total	42	100.0
AKIN stage Day-7	Frequency	%	RIFLE stage Day-7	Frequency	%
1.0	21	70	F	5	16.7
2.0	4	13.3	I	5	16.7
3.0	5	16.7	R	20	66.6
Total	30	100.0	Total	30	100.0
AKIN stage Day-8	Frequency	%	RIFLE stage Day-8	Frequency	%
1.0	11	61.1	F	2	11.1
2.0	5	27.8	I	6	33.3
3.0	2	11.1	R	10	55.6
Total	18	100.0	Total	18	100.0
AKIN stage Day-9	Frequency	%	RIFLE stage Day-9	Frequency	%
1.0	8	61.5	F	2	15.4
2.0	3	23.1	I	4	30.8
3.0	2	15.4	R	7	53.8
Total	13	100.0	Total	13	100.0
AKIN stage Day-10	Frequency	%	RIFLE stage Day-10	Frequency	%
1.0	7	77.8	F	1	11.1
2.0	1	11.1	I	1	11.1
3.0	1	11.1	R	7	77.8
Total	9	100.0	Total	9	100.0

In Day 2 we have AKIN - stage 1 -47[72.3%], stage 2-4[6.2%],stage 3-14[21.5], in Day 3 stage 1- 48[73.8%], stage 2 - 7[10.8%], stage 3- 10 [15.4%], in Day 4 stage 1- 47 [77%], stage 2- 5 [8.2%], , stage 3 - 9[14.8], in Day 5 stage 1 -40 [76.9%], stage 2- 1[1.9%], stage 3 - 11[21.2%], in Day 6 stage 1- 28 [66.7%] stage 2 - 5[11.9%], stage 3 - 9[21.4%], in Day 7 stage 1- 21[70%], stage 2 - 4[13.3%], stage 3 5[16.7%], in Day 8 stage 1 -11[61.1%], stage2 - 5[27.8%], stage 3 - 2[11.1%], in Day 9 stage 1- 8[61.5%], stage 2 3[23.1%], stage 3 2[15.4%], in day 10 stage1- 7[77.8%], stage 2- 1[11.1%], stage 3-1[11.1%].

According to RIFLE class, in Day 2 R- 47[72.3%], I-4[6.2%], F-14[21.5%], Day 3 - R- 48[73.8%], I- 7[10.8%], F- 10 [15.4%], in Day 4-R- 48[78.7%], I-4[6.6%], F- 9[14.7%], in Day 5 - R-41[78.9%], I-0, F- 11[21.1%], in Day 6- R- 29[69.1], I- 4[9.5%], F- 9[21.4%], in Day 7 R- 20[66.6%], I- 5[16.7%], F- 5[16.7%] in Day 8 R-10[55.6%], I- 6[33.3%], F-2 [11.1%], in Day 9 - R- 7[53.8%], I- 4[30.8%], F- 2[15.4%], in Day 10 R- 7[77.8%], I-1 [11.1%], F-1[11.1%].

AKIN VS RIFLE

RIFLE stage	AKIN stage Day-2						Total	
	1.0		2.0		3.0		Count	%
Day-2	Count	%	Count	%	Count	%	Count	%
F	0	0.0%	0	0.0%	14	100.0%	14	21.5%
I	0	0.0%	4	100.0%	0	0.0%	4	6.2%
R	47	100.0%	0	0.0%	0	0.0%	47	72.3%
Total	47	100.0%	4	100.0%	14	100.0%	65	100.0%
RIFLE stage	AKIN stage Day-3						Total	
	1.0		2.0		3.0		Count	%
Day-3	Count	%	Count	%	Count	%	Count	%
F	0	0.0%	0	0.0%	10	100.0%	10	15.4%
I	0	0.0%	7	100.0%	0	0.0%	7	10.8%
R	48	100.0%	0	0.0%	0	0.0%	48	73.8%

Total	48	100.0%	7	100.0%	10	100.0%	65	100.0%
RIFLE stage Day-4	AKIN stage Day-4						Total	
	1.0		2.0		3.0		Count	%
	Count	%	Count	%	Count	%	Count	%
F	0	0.0%	0	0.0%	9	100.0%	9	14.8%
I	0	0.0%	4	80.0%	0	0.0%	4	6.6%
R	47	100.0%	1	20.0%	0	0.0%	48	78.7%
Total	47	100.0%	5	100.0%	9	100.0%	61	100.0%

P<0.001

RIFLE DAY-5	AKIN DAY-5						Total	
	1		2		3		Count	%
Count	%	Count	%	Count	%	Count	%	
F	0	0.0%	0	0.0%	11	100.0%	11	21.2%
R	40	100.0%	1	100.0%	0	0.0%	41	78.8%
Total	40	100.0%	1	100.0%	11	100.0%	52	100.0%

P<0.001

RIFLE stage Day-6	AKIN stage Day-6						Total	
	1.0		2.0		3.0		Count	%
	Count	%	Count	%	Count	%	Count	%
F	0	0.0%	0	0.0%	9	100.0%	9	21.4%
I	1	3.6%	3	60.0%	0	0.0%	4	9.5%
R	27	96.4%	2	40.0%	0	0.0%	29	69.1%
Total	28	100.0%	5	100.0%	9	100.0%	42	100.0%

P<0.001

RIFLE stage Day-7	AKIN stage Day-7						Total	
	1.0		2.0		3.0		Count	%
	Count	%	Count	%	Count	%	Count	%
F	0	0.0%	0	0.0%	5	100.0%	5	16.7%
I	1	4.8%	4	100.0%	0	0.0%	5	16.7%
R	20	95.2%	0	0.0%	0	0.0%	20	66.7%
Total	22	100.0%	4	100.0%	4	100.0%	30	100.0%

P<0.001

Akin And Rifle Staging For Requirement Of Haemodialysis In Aki Patients

AKIN Day-2	Dialysis 0				Dialysis 1				Dialysis 2					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%		
1	40	90.9%	7	33.3%	1	39	88.6%	9	42.9%	1	37	90.2%	10	50.0%
2	0	0%	4	19.0%	2	4	9.1%	3	14.3%	2	4	9.8%	1	5.0%
3	4	9.1%	10	47.6%	3	1	2.3%	9	42.9%	3	0	0%	9	45.0%
Total	44	100.0%	21	100.0%	Total	44	100.0%	21	100.0%	Total	41	100.0%	20	100.0%
AKIN Day-5	Dialysis 0				Dialysis 1				Dialysis 2					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%		
1	30	93.8%	10	50.0%	1	19	86.4%	9	47.4%	1	13	86.7%	8	53.3%
2	0	0%	1	5.0%	2	3	13.6%	1	5.3%	2	2	13.3%	2	13.3%
3	2	6.3%	9	45.0%	3	0	0%	9	47.4%	3	0	0%	5	33.3%
Total	32	100.0%	20	100.0%	Total	22	100.0%	19	100.0%	Total	15	100.0%	15	100.0%
RIFLE Day-2	Dialysis 0				Dialysis 1				Dialysis 2					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%		
F	4	9.1%	10	47.6%	F	1	2.3%	9	42.9%	F	0	0%	9	45.0%
I	0	0%	4	19.0%	I	4	9.1%	3	14.3%	I	4	9.8%	0	0%
R	40	90.9%	7	33.3%	R	39	88.6%	9	42.9%	R	37	90.2%	11	55.0%
Total	44	100.0%	21	100.0%	Total	44	100.0%	21	100.0%	Total	41	100.0%	20	100.0%
RIFLE Day-5	Dialysis 0				Dialysis 1				Dialysis 2					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%		
F	2	6.3%	9	45.0%	F	0	0%	10	52.7%	F	0	0%	5	33.3%
R	30	93.8%	11	55.0%	R	3	13.0%	0	0%	I	2	13.3%	3	20.0%
Total	32	100.0%	20	100.0%	Total	23	100.0%	19	100.0%	Total	15	100.0%	15	100.0%

Rifle And Akin Staging For Detecting Mortality In Aki Patients

RIFLE Day-2	Mortality 0				Mortality 1				Mortality 2					
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%		
F	13	21.3%	1	25.0%	F	9	14.8%	1	25.0%	F	8	14.0%	1	25.0%
I	4	6.6%	0	0.00%	I	7	11.5%	0	0%	I	4	7.0%	0	0%
R	44	72.1%	3	75.0%	R	45	73.8%	3	75.0%	R	45	78.9%	3	75.0%
Total	61	100.0%	4	100.0%	Total	61	100.0%	4	100.0%	Total	57	100.0%	4	100.0%

RIFLE	Mortality				RIFLE Day-6	Mortality				RIFLE Day-7	Mortality			
	0		1			0		1			0		1	
	Count	%	Count	%		Count	%	Count	%		Count	%	Count	%
Day-5														
F	10	20.8%	1	25.0%	F	9	23.1%	1	33.3%	F	5	17.2%	0	0%
R	38	79.2%	3	75.0%	R	27	69.2%	2	66.7%	R	19	65.5%	1	100.0%
Total	48	100.0%	4	100.0%	Total	39	100.0%	3	100.0%	Total	29	100.0%	1	100.0%

AKIN	Mortality				AKIN Day-3	Mortality				AKIN Day-4	Mortality			
	0		1			0		1			0		1	
	Count	%	Count	%		Count	%	Count	%		Count	%	Count	%
Day-2														
1	44	72.1%	3	75.0%	1	45	73.8%	3	75.0%	1	44	77.2%	3	75.0%
2	4	6.6%	0	0%	2	7	11.5%	0	0%	2	5	8.8%	0	0%
3	13	21.3%	1	25.0%	3	9	14.8%	1	25.0%	3	8	14.0%	1	25.0%
Total	61	100.0%	4	100.0%	Total	61	100.0%	4	100.0%	Total	57	100.0%	4	100.0%

AKIN	Mortality				AKIN Day-6	Mortality				AKIN Day-7	Mortality			
	0		1			0		1			0		1	
	Count	%	Count	%		Count	%	Count	%		Count	%	Count	%
Day-5														
1	37	77.1%	3	75.0%	1	26	68.4%	2	66.7%	1	20	69.0%	1	100.0%
2	1	2.1%	0	0%	2	4	10.5%	0	0%	2	4	13.8%	0	0%
3	10	20.8%	1	25.0%	3	8	21.1%	1	33.3%	3	5	17.2%	0	0%
Total	48	100.0%	4	100.0%	Total	38	100.0%	3	100.0%	Total	29	100.0%	1	100.0%

Statistical analysis:

Data were entered in MS-Excel and analyzed in SPSS V22. Descriptive statistics were represented with percentages, Mean with SD. Chi-square test was applied to find significance. P<0.05 was considered as statistically significant.

DISCUSSION

In our study 17(26.1%) were diabetic, 10(15.3%) were hypertensive out of 65 patients. In a study conducted by Hamid SA et al Hypertension and diabetes were in 38.1% and 28.8%, respectively (6).

OUTCOME

In our present study of 65 patients, 21[32.3%] patients required hemodialysis. In the present study AKI due to various causes associates with septicemia and septic shock had high mortality. Out of 11 AKI cases due to sepsis associated causes 2(3%) cases died. These finding are comparable to study done by Nevu H et al, who found mortality of 74.5%(18).

In a study by Elrewhby WH et al(19) they studied 851 patients out of that 21 [2.4.1%] patient required hemodialysis, compared to our study were 32.3% patients of AKI required hemodialysis. In a similar study of Acute kidney injury in intensive care unit by Hamid SA et al(20) in the study they enrolled 106 AKI patients among them 24 [22.9%] patients required HD.

AKIN Vs RIFLE

We conclude AKIN classification helps to predict the prognosis of the patient better than the RIFLE classification. Which is compared to a study conducted by Shacham Y et al(21) concluded that the AKIN criteria allowed the identification of more patients as having AKI (9.6 vs. 3.9 %, p < 0.001) and classified more patients with stage 1 (risk in RIFLE) (7.6 vs. 1.9 %, p < 0.001) compared with the RIFLE criteria. Mortality was higher in AKI population defined by either RIFLE (46.3 vs. 6.8 %, OR 11.9, 95 % CI 6.15-23.1; p < 0.001) or AKIN (29 vs. 6.1 %; OR 6.3, 95 % CI 3.8-10.4; p < 0.001) criteria. In a study by Lopes JA et al (3) concluded that, total 662 patients (mean age, 58.6 ± 19.2 years; 392 males) were evaluated. AKIN criteria allowed the identification of more patients as having acute kidney injury (50.4% versus 43.8%, P = 0.018) and classified more patients with Stage 1 (risk in RIFLE) (21.1% versus 14.7%, P = 0.003), but no differences were observed for Stage 2 (injury in RIFLE) (10.1% versus 11%, P = 0.655) and for Stage 3 (failure in RIFLE) (19.2% versus 18.1%, P = 0.672).

SUMMARY

A prospective study of 65 cases was carried out at our hospital SNMC & HSK HOSPITAL, Bagalkot. The inclusion and exclusion criteria were followed as per the Criteria mentioned in material and methods

- 1) The age range was 20 to 85 years , male to female ratio was 56.9 : 43.1
- 2) A definitive diagnosis was made in all the included cases in our study
- 3) Among the diagnosed cases, sepsis accounted the most common etiology [16.9%]
- 4) Second common cause was UTI [13.8%] followed by pneumonia [9.2%] and gastro enteritis [7.6%]
- 5) Diabetes [26.1%] is the most common co morbidity associated with patients included in our study
- 6) In our present study of 65 patients, 21[32.3%] patients required hemodialysis and AKI due to various causes associates with septicemia and septic shock had high mortality
- 7) Four of the patients died during the hospital stay.
- 8) Most of the patients had good clinical improvement.

- 9) From Day 3 onwards with AKIN had better predictability of AKI also helps to identify patients requires hemodialysis
- 10) AKIN does not seem to improve in predicting inhospital mortality of critically ill patients

CONCLUSION

In our study AKIN is a better predictor for assessing the need of hemodialysis compared to RIFLE criteria. Though our study conducted in a very small population we have tried comparing both AKIN and RIFLE criteria.

But this we cannot conclude AKIN is better over RIFLE as our sample size is less. Other parameter include hyperkalemia, acidosis is also predict need of hemodialysis which is not included in both AKIN and RIFL criteria.

REFERENCES

1. 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 Aug;8(4):R204-212.
2. Hoste EA, Clermont G, Kersten A, Venkataraman R, Angus DC, De Bacquer D, et al. RIFLE criteria for acute kidney injury are associated with hospital mortality in critically ill patients: a cohort analysis. Crit Care. 2006;10(3):R73.
3. Lopes JA, Fernandes P, Jorge S, Gonçalves S, Alvarez A, Costa e Silva Z, et al. Acute kidney injury in intensive care unit patients: a comparison between the RIFLE and the Acute Kidney Injury Network classifications. Crit Care. 2008;12(4):R110.
4. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG, et al. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. Crit Care. 2007;11(2):R31.
5. Bernieh B, Al Hakim M, Boobes Y, Abuchacra S, Dastoor H. Pattern of acute renal failure in a tertiary hospital in the United Arab Emirates. Transplantation Proceedings. 2004 Jul;36(6):1780-3.
6. al HS et. Acute kidney injury in intensive care unit, hospital Universiti Sains Malaysia: A descriptive study. - PubMed - NCBI [Internet]. [cited 2018 Nov 19]. Available from: https://www.ncbi.nlm.nih.gov/pubmed/30381507
7. Maccariello E, Soares M, Valente C, Nogueira L, Valença RVR, Machado JES, et al. RIFLE classification in patients with acute kidney injury in need of renal replacement therapy. Intensive Care Med. 2007 Apr;33(4):597-605.
8. Vikrant S, Gupta D, Singh M. Epidemiology and outcome of acute kidney injury from a tertiary care hospital in India. Saudi J Kidney Dis Transpl. 2018 Aug;29(4):956-66.
9. Goswami S, Pahwa N, Vohra R, Raju BM. Clinical spectrum of hospital acquired acute kidney injury: A prospective study from Central India. Saudi J Kidney Dis Transpl. 2018 Aug;29(4):946-55.
10. Mansuri U, Patel AA, Dave M, Chauhan K, Shah AS, Banala R, et al. Impact of Dialysis Requirement in Community-acquired Pneumonia Hospitalizations. Cureus. 2018 Aug 20;10(8):e3164.
11. Mahesh E, Nallamuthu P, Kumar M, Madhyastha PR, Konanna G. Clinical profile of geriatric acute kidney injury in a tertiary care center from south India. Saudi J Kidney Dis Transpl. 2017 Aug;28(4):886-90.
12. Mehta K, Pajai A, Bhurke S, Shirkanade A, Bhadade R, D'Souza R. Acute Kidney Injury of Infectious Etiology in Monsoon Season: A Prospective Study Using Acute Kidney Injury Network Criteria. Indian J Nephrol. 2018 Apr;28(2):143-52.
13. Evans RDR, Hemmila U, Craik A, Mtekatema M, Hamilton F, Kawale Z, et al. Incidence, aetiology and outcome of community-acquired acute kidney injury in medical admissions in Malawi. BMC Nephrol. 2017 14;18(1):21.
14. Jayawardana S, Arambepola C, Chang T, Gnanathanan A. Long-term health complications following snake envenoming. Journal of Multidisciplinary Healthcare. 2018;11:279.
15. Vikrant S, Jaryal A, Parashar A. Clinicopathological spectrum of snake bite-induced acute kidney injury from India. World Journal of Nephrology. 2017 May 6;6(3):150.
16. Danis R, Ozmen S, Celen MK, Akin D, Ayaz C, Yazanel O. Snakebite-induced acute kidney injury: data from Southeast Anatolia. Ren Fail. 2008;30(1):51-5.
17. Hsiao C-Y, Yang H-Y, Hsiao M-C, Hung P-H, Wang M-C. Risk Factors for Development of Acute Kidney Injury in Patients with Urinary Tract Infection. PLoS ONE. 2015;10(7):e0133835.
18. Neveu H, Kleinknecht D, Brivet F, Loirat P, Landais P. Prognostic factors in acute renal failure due to sepsis. Results of a prospective multicentre study. The French Study Group on Acute Renal Failure. Nephrol Dial Transplant. 1996 Feb;11(2):293-9.
19. Elrewhby WH, Hasan NF, Fikry W, Wafa E. Acute kidney injury in hospitalized patients during muslim pilgrimage (Hajj): 1432). Saudi J Kidney Dis Transpl. 2018 Oct;29(5):1128-32.
20. Hamid S-AA, Adnan W-N-AW, Naing NN, Adnan AS. Acute kidney injury in intensive care unit, hospital Universiti Sains Malaysia: A descriptive study. Saudi J Kidney Dis Transpl. 2018 Oct;29(5):1109-14.
21. Shacham Y, Leshem-Rubinow E, Ziv-Baran T, Gal-Oz A, Steinvil A, Ben Assa E, et al. Incidence and mortality of acute kidney injury in acute myocardial infarction patients: a comparison between AKIN and RIFLE criteria. Int Urol Nephrol. 2014 Dec;46(12):2371-7.