Assessment of RIFLE criteria for acute kidney injury patients in tertiary care teaching hospital

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***Abstract*- This Acute kidney injury (AKI) is a common and serious complication in critically ill patients. It is frequently caused by insufficient renal perfusion as a result of severe trauma, sickness, or surgery, but it can also be caused by a quickly advancing, intrinsic renal disease. Acute kidney injury (AKI) affects 3–7 % of patients admitted to the hospital and approximately 25–30 % of patients in the intensive care unit. The widespread use of RIFLE and classification system for acute kidney injury (AKI) diagnosis and staging have established the association between AKI severity and adverse outcomes. *It is defined as Risk, Injury, Failure, Loss and End-stage renal failure (RIFLE)* need to be validated in different patient groups. RIFLE may be useful to foresee medical and logistic problems.**

***Index Terms*- Acute kidney injury, serum analysis, clearance rate, GFR, RIFLE assessment, Urine output.**

I. INTRODUCTION

ANATOMY & PHYSIOLOGY OF RENAL SYSTEM : The urinary system is the main excretory system which plays a vital part in maintaining homeostasis of water and electrolytes within the body. Kidneys are bean-shaped organs, about 11 cm long, 6 cm wide, 3 cm thick and weigh 150 g which lie on the posterior abdominal wall, one on each side of the vertebral column, behind the peritoneum and below the diaphragm. They extend from the level of the 12th thoracic vertebra to the 3rd lumbar vertebra, receiving some protection from the lower rib cage. The right kidney is usually slightly lower than the left, probably because of the considerable space occupied by the liver. The kidneys produce urine that contains metabolic waste products, including the nitrogenous compounds urea and uric acid, excess ions and some drugs. It consists of the following structures:

- 2 kidneys, which secrete urine
- 2 ureters that convey the urine from the kidneys to the urinary bladder
- the urinary bladder, which collects and stores urine
- the urethra through which urine leaves the body.

FUNCTIONS:

- formation of urine, maintaining water, electrolyte and acid–base balance
- excretion of waste products
- production and secretion of erythropoietin, the hormone that stimulates formation of red blood cells
- production and secretion of renin, an important enzyme in the control of blood pressure. [1]

ACUTE KIDNEY INJURY: Acute kidney injury (AKI), also known as acute renal failure (ARF), it refers an abrupt decrease in kidney function, resulting in the retention of urea and other nitrogeneous waste products and in the dysregulation of extracellular volume and electrolytes. Acute kidney injury (AKI) can also affect other organs such as the brain, heart, and lungs.[2]

CAUSES OF ACUTE KIDNEY INJURY:

PRE-RENAL	RENAL	POST-RENAL
Impaired perfusion:	➢ Glomerulonephritis	➢ Urinary calculi
➢ **Cardiac failure**	➢ Small-vessel vasculitis	➢ Retroperitoneal fibrosis
➢ **Sepsis**	➢ Acute tubular necrosis	➢ Benign prostatic enlargement
➢ **Blood loss**	➢ Drugs	➢ Prostate cancer
➢ **Dehydration**	➢ Toxins	➢ Cervical cancer
➢ **Vascular occlusion**	➢ Prolonged hypotension	

	➢ Interstitial nephritis Drugs ➢ Toxins ➢ Inflammatory disease ➢ Infection	➢ Urethral stricture/valves ➢ Mental stenosis/phimosis[3]	

GLOMERULAR FILTRATION RATE (GFR)

- ➢ It is a measure of volume of blood filtered by kidneys during specific time period.
- ➢ eGFR is a test that determines how effectively kidney perform. It is also a measure of renal function.
- ➢ Although quantity of creatinine in blood is a good indicator of renal function, the eGFR is more precise.
- ➢ Usual eGFR range 90 – 120 ml/min.
- ➢ An eGFR < 60 ml/min indicates that renal damage has occurred.
- ➢ The more the number decreases the severity of the renal disease increases.[4]

Cockcroft-Gault Formula:

Serum creatinine levels may be used to calculate eGFR based on age , gender and weight.

The Cockcroft and Gault formula (1973)

- GFR=(140–age) x weight)/(72xS_{Cr})
- GFR={(140–age) x weight)/(72xS_{Cr})}x 0.85 (if female)

Abbreviations/ Units

- GFR(Glomerular Filtration Rate) = mL/minute
- Age = in years
- Weight = in kgs
- SCr (serum creatinine) = mg/dL[5]

RIFLE (Risk, Injury, Failure, Loss of function and End stage renal disease) CLASSIFICATION:

The RIFLE(Risk, Injury, Failure, Loss of function, End stage renal disease) classification is a simple, readily available clinical tool to classify Acute Kidney Injury in different populations. It seems to be a good outcome predictor, with a progressive increase in mortality with worsening RIFLE(Risk, Injury, Failure, Loss of function, End stage renal disease) class. l .

RIFLE	Serum Creatinine	Urine Output(ml/kg/hr)	Glomerular Filtration Rate
RISK	Increases by 1.5	Less than 0.5 for 6 hrs	Decreases by 25%
INJURY	Increases by 2.0	Less than 0.5 for 12 hrs	Decreases by 50%
FAILURE	Increases by 3.0	Less than 0.5 for 24 hrs (anuria)	Decreases by 75%
LOSS OF FUNCTION	Loss of function for >4weeks.		
END STAGE RENAL DISEASE (ESRD)	Renal Replacement Therapy >3 months, should go for dialysis.[6]		

II. AIMS AND OBJECTIVE

AIM: To assess the RIFLE (Risk, Injury, Failure, Loss of function and End stage renal disease) criteria in Acute kidney injury patients.

OBJECTIVES:

- ➢ To detect prevalence of Acute kidney injury in renal & non-renal patients and hospital mortality.
- ➢ To determine the correlation between serum creatinine and glomerular filtration rate.

III. MATERIALS AND METHODS

- ➢ **STUDY DESIGN:** Prospective observational.
- ➢ **STUDY PERIOD:** 6 months.
- ➢ **STUDY SITE:** Department of general medicine at Malla Reddy Hospitals.
- ➢ **SAMPLE SIZE:** 150 Patients.

➢ **ELIGIBILITY CRITERIA:**

A.	**INCLUSION CRITERIA**	✓ **All patients with abnormalities in Serum creatinine, urine output, Glomerular filtration rate are considered.** ✓ **Both genders** ✓ **Age >18 years** ✓ **All the patients willing to participate in the study.**
B.	**EXCLUSION CRITERIA**	✓ **Stay in hospital < 24 hours** ✓ **Patients below 18 years** ✓ **Kidney transplant patients** ✓ **Patients on dialysis** ✓ **Chronic kidney disease patients.**

STUDY MATERIALS

➢ Data collection form

➢ Informed consent form

METHODOLOGY: STUDY PROCEDURE

➢ It is a prospective observational study on "Assessment of RIFLE criteria for Acute Kidney Injury*"* conducted at Malla Reddy Hospitals, Suraram, Hyderabad.

➢ Study procedure was explained to the subject and informed consent was obtained from patients individually. After obtaining ethical clearance, all required information was collected from patient's profile form and from patients by using data collection form.

➢ Clinically suspected Acute Kidney Injury patients were interviewed to collect socio-demographic data, clinical data.

➢ Serum creatinine and glomerular filtration rate (GFR) values were obtained from laboratory reports. Urine output values were obtained using I/O (input/output) charting.

➢ If Glomerular filtration rate was not estimated in laboratory testing, we calculated using Cockcroft-Gault Formula.

➢ Thereafter the stratification and analysis of the results was done.

IV. RESULTS

STASTICAL ANALYSIS:

Data was entered into Microsoft Excel and statistical analysis was carried out using Statistical Package for Social Sciences (SPSS) for Microsoft Windows. Continuous variables like age were reported using mean and standard deviation. Categorical data are expressed as proportions, and subgroups were analysed using Chi-square test . Multivariate analysis done using ANOVA.

RESULTS: DESCRIPTIVE STATISTICS

CATEGORY	N	MIN	MAX	MEAN	STANDARD DEVIATION	MEDIAN
AGE (in yrs)	150	28	83	54.1	12.40	55
WEIGHT (in kgs)	150	36	83	59.8	9.87	60
RIFLE (Sr.Cr)	150	0.8	12	4.28	2.48	4.1
RIFLE (GFR)	150	6	88	23.2	15.76	18

TABLE 2: Distribution of RIFLE class among patients based on Serum Creatinine (Sr.Cr) criteria:

CATEGORY	FREQUENCY	RATIO(%)
R (Sr.Cr 1.2-1.8)	29	19.3%
I (SR.Cr 1.9-2.4)	34	22.7%
F(Sr.Cr 2.5-3.6)	10	6.7%
NONE	77	51.3%
TOTAL	150	100%

TABLE 3: Distribution of RIFLE class among patients based on Glomerular Filtration Rate (GFR)

CATEGORY	FREQUENCY	RATIO(%)
R (>67.5)	1	0.7%
I (45-67.5)	16	10.7%
F (22.5-45)	51	34.0%
NONE	82	54.7%
TOTAL	150	100%

TABLE 4: Distribution of RIFLE class among study subjects based on Urine Output Criteria:

CATEGORY	FREQUENCY	RATIO(%)
R (<0.5ml in 6hrs)	0	0 %
I (<0.5ml in 12 hrs)	83	55.3 %
F (<0.3ml in 24 hrs)	25	16.7 %
NONE	42	28 %
TOTAL	150	100 %

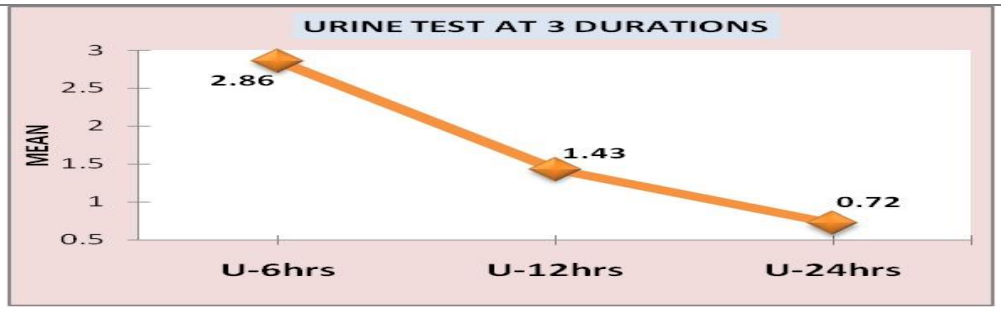
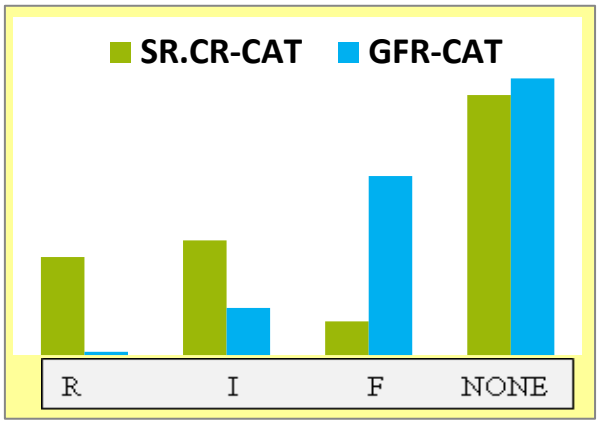


Fig no.1 Comparison of Urine output at three different intervals

CATEGORY	SERUM CREATININE	GFR	*p* - value
R	29	1	**0.000** [significant]
I	34	14	
F	10	53	
NONE	77	82	

TOTAL	**150**	**150**	

TABLE 5: Comparison of RIFLE class among patients based on GFR vs Serum Creatinine categories.



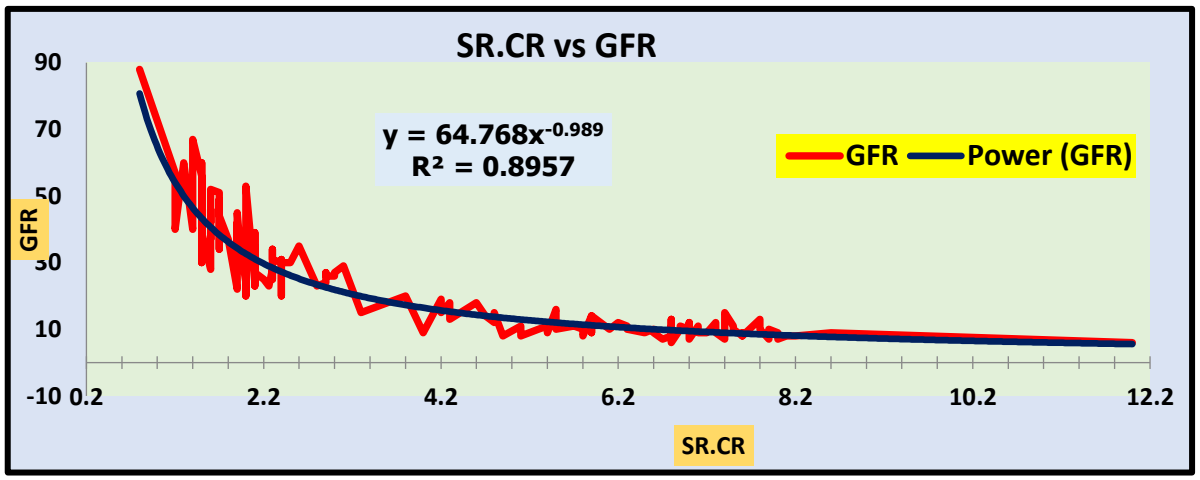


Fig.no 2: Graph depicting correlation between serum creatinine and glomerular filtration rate among patients.

V. DISCUSSION & CONCLUSION:

The RIFLE criteria provided a structured framework for stratifying the severity of AKI, facilitating better clinical decision-making and patient management. The classification system's differentiation between Risk, Injury, Failure, Loss of function, and End-stage renal disease stages offered a nuanced understanding of AKI progression. The incorporation of both serum creatinine and urine output as diagnostic markers enhances the accuracy of AKI diagnosis and classification, providing a more comprehensive assessment of renal function.

In our study, we found few numbers of comorbidities, and they were distributed between the RIFLE serum creatinine (Scr) and RIFLE glomerular filtration rate (GFR) AKI groups, with a significant *p value* for each of these groups being *0.000*.With 43 patients (28.7%), the most prevalent comorbidity was hypertension and diabetes mellitus. Hypertension is the next frequent comorbidity; there are 37 patients overall (or 24.7%).20% of patients had comorbid conditions like osteoarthritis, LRTI, hepato-encephalopathy, nephrotic syndrome, cirrhosis, fatty liver, CCF, CAD, renal calculi, hepatitis, AV block, abnormal wall motion, etc are all together included into miscellaneous category , while only nine out of 150 patients did not have any comorbid conditions.

As indicated by the ANOVA analysis, the decreasing trend in mean values with increasing duration of urine output suggests that urine output tends to decrease over time. This observation could be relevant for understanding the progression of acute kidney injury in patients.
p-value was found to be significant at *0.00001* using One way ANOVA **(Fig.no1)**

In this study it was evident that the majority of patients with a severity rating based on **Serum Creatinine (Sr.Cr)** criteria categories showed that n=34, 22.7% at injury, followed by n=29,19.3% at risk, and n=10, 6.7% at failure and n=77,51% were observed to have peaked serum creatinine values and were considered as none category [They may either fall into L(loss of function) or E (End stage renal disease) categories]. **Fig.no.2**

p-value was found to be significant at *0.0034* using Chi-square analysis.

In addition, our study demonstrated the comparative analyses to explore associations between different variables and RIFLE classes, and to compare the urine output during three intervals and also findings the significant correlation between serum creatinine and glomerular filtration rate. In order to investigate the relationships between various variables and RIFLE classes, comparative studies were carried out. In the study, significant correlations between GFR and age, gender, weight, cause of AKI, and comorbidities were discovered (all *p-values <0.05*). These results imply that these variables might have an effect on Glomerular Filtration Rate and, as a result, on how patients with acute kidney injury were classified by RIFLE. Comparison of urine output during three intervals, The declining trend in mean values with increasing urine output duration, as shown by the ANOVA analysis, implies that urine output tends to decrease over time. This finding may be important for understanding how acute kidney injury progresses in patients. An evident finding from our study was that, in patients with acute kidney injury, there is a significant correlation between serum creatinine and glomerular filtration rate (GFR), as demonstrated by the *p-value of 0.000*, when RIFLE class is compared between patient groups based on GFR and serum creatinine levels. The research was in favour of the inverse relationship between serum creatinine and GFR, where higher levels of serum creatinine are linked to lower levels of GFR.

Ultimately, the application of the RIFLE classification system provides a comprehensive and clinically relevant approach to assessing Acute Kidney Injury. The study's results underscore the importance of early detection, accurate classification, and timely intervention to mitigate the impact of AKI on patient outcomes. Moving forward, integrating the RIFLE criteria into clinical practice has the potential to enhance patient care and contribute to improved health care management strategies for AKI.

STRENGTHS

- **Comprehensive Data Collection**: Our study collects a variety of patient information, including age, gender, weight, comorbidities, and clinical parameters such as serum creatinine, glomerular filtration rate, and urine output. This comprehensive approach can provide a more holistic understanding of the factors influencing acute kidney injury.
- **Multiple Analytical Approaches:** Our study employs various statistical analyses, such as ANOVA, Pearson's Chi-square and p-values, Unpaired t-test to examine the relationships between different variables, contributing to a more robust interpretation of the results.

LIMITATIONS

- **Single-Centre Study:** Conducting the study in a single tertiary care teaching hospital might limit the diversity of patient demographics, disease severity, and treatment approaches, potentially impacting the external validity of the results.
- **Limited Follow-up Period:** A study period of only 6 months might not capture long-term outcomes, such as chronic kidney disease progression, that could result from acute kidney injury.

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