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Original Research Paper

Nephrology

SERUM CYSTATIN C CONCENTRATION LEVELS AS A MARKER OF ACUTE KIDNEY INJURY

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ABSTRACT

BACKGROUND: Acute kidney injury (AKI) is a common complication in patients admitted to the intensive care unit (ICU). It is common in hospitalized patients, with a mortality rate between 30% and 90% depending upon various causes.1Acute kidney injury is the abrupt loss of kidney function sufficient to decrease urinary elimination of nitrogenous waste (urea nitrogen and creatinine) .In clinical practice, the detection of AKI, which is characterized by a rapid decline of the glomerular filtration rate (GFR), is based on increase of serum creatinine (Sr. Creatinine). However, there are major limitations to the use of creatinine for estimating GFR. Minor changes of Sr. Creatinine, as typically seen early in acute renal failure, may already reflect substantial decline in GFR. Sr. Creatinine inaccurately estimates GFR due to tubular secretion and reabsorption of creatinine.2Sr. Creatinine can be affected by age, sex, muscle mass, drugs and diet.3The early and accurate detection of acute renal failure is crucial to prevent its progression, and thereby, to potentially improve its outcome.Hence there is a need of a early and more reliable marker of ARF which can detect minor GFR reduction and which is not affected by age, sex, muscle mass, drugs and diet. Many international studies say that Serum Cystatin C (Sr. cystatin C) is one such marker but there is lack of Indian studies regarding Sr. Cystatine C levels as a marker of acute renal failure in critically ill patients. To date no studies on Sr. Cystatin C are done in Telangana. Hence the present study was undertaken to assess whether Sr. Cystatin C is a early and more reliable marker of AKI. **AIM:** To evaluate the Serum Cystatin C concentration levels as a marker of acute kidney injury

OBJECTIVES:

1) To compare serum Cystatin C level with Serum Creatinine as a marker of Acute Kidney Injury
2) To study the severity of Acute Kidney Injury based on Serum Cystatin C.

STUDY DESIGN: Cross-sectional study **PLACE OF STUDY:** Department of General Medicine, Kamineni institute of medical sciences, Narketpally. **DURATION OF STUDY:** October 2020 to September 2022.

KEYWORDS : Acute kidney injury, Serum Cystatine C, Serum Creatinine, Glomerular Filtration Rate

INTRODUCTION:

Acute kidney injury (AKI) is a common complication in patients admitted to the intensive care unit (ICU). It is common in hospitalized patients, with a mortality rate between 30% and 90% depending upon various causes.[1]

Acute kidney injury is the abrupt loss of kidney function sufficient to decrease urinary elimination of nitrogenous waste (urea nitrogen and creatinine) .The relative importance of factors contributing to ARF will be different depending on the underlying pathology and patient characteristics.The large differences in mortality for patients with ARF, as reported in recent trials (varying between 28 and 83%) can possibly be explained by differences in patient population.[4,5]

However, there are major limitations to the use of creatinine for estimating GFR. Minor changes of Sr. Creatinine, as typically seen early in acute renal failure, may already reflect substantial decline in GFR. Sr. Creatinine inaccurately estimates GFR due to tubular secretion and reabsorption of creatinine.[2]Sr. Creatinine can be affected by age, sex, muscle mass, drugs and diet.[3]

The early and accurate detection of acute renal failure is crucial to prevent its progression, and thereby, to potentially improve its outcome. Hence there is a need of a early and more reliable marker of ARF which can detect minor GFR reduction and which is not affected by age, sex, muscle mass, drugs and diet. Many international studies say that Serum Cystatin C (Sr. cystatin C) is one such marker but there is lack of Indian studies regarding Sr. Cystatine C levels as a marker of acute renal failure in critically ill patients. To date no studies on Sr. Cystatin C are done in Telangana. Hence the present study was undertaken to assess whether Sr. Cystatin C is a early and more reliable marker of AKI.

AIM:

To evaluate the Serum Cystatin C concentration levels as a marker of acute kidney injury

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Inclusion Criteria:

Patients at risk of developing ARF (all patients of medical intensive care unit without coexiciting/known acute or chronic renal failure)

Exclusion Criteria:

Acute and Chronic Renal Failure.

METHODOLOGY:

After taking approval from the institutional ethics committee and prior informed consent from the patients the study was conducted.

The patients with normal Sr. Creatinine that is ≤ 1.3 mg/dl and willing to participate were included in the study after obtaining their informed consent.Patients with acute or chronic renal failure that is Sr. Creatinine > 1.3 mg/dL were excluded from the study.[2]

All base line investigations as per the predesigned and pretested proforma like complete blood count, liver function test, renal function test, urine routine and microscopy were done.S. Cystatin C levels were determined at admission and these were considered as the first reading.

Sr. Cystatin C was done by serum nephelometry method. Any value above 0.95 mg/l was considered high.[6]Further Sr. Creatinine was done daily for five days in all the patients to know whether the patient has developed AKI.In this study ARF is detected according to first three RIFLE (the Risk of renal dysfunction, Injury to the kidney, Failure of the kidney function, Loss of kidney function and End Stage Renal Disease) criteria of the GFR domain.

First three RIFLE criteria of GFR domain are;[8]
R-criteria is raise in creatinine by ≥ 50%
I-criteria is raise in creatinine by ≥ 100%
F-criteria is raise in creatinine by ≥ 200%

Once there was increase in Sr. Creatinine of more than or equal to fifty percentage from baseline, Sr. Cystatine C levels were repeated. The values of Sr.Creatinine and Sr.Cystatin C on this day were considered as the second readings.In the patients who did not develop ARF, Sr.Cystatin C was done on day 5. These patients were considered as controls.

Statistical Methods

The data was tabulated and analysed using rates, ratios, percentages. The comparison was done using chi-square test and student-t test. A probability value ('p' value) of less than or equal to 0.05 was considered as statistically significant.

RESULTS:

Table 1: Gender Distribution

Gender	Distribution(N=50)	
	Number	Percentage
Male	33	66 %
Female	17	34 %
Total	50	100 %

In the present study out of 50 patients,33(66%) were male and 17 (34%) were female. The male: female ratio was 1.94:1.

Table- 2: Age Distribution

Age Group(Years)	Distribution(N=50)	
	Number	Percentage
18-30	13	26 %
31-45	12	24 %
46-60	12	24 %
>60	13	26%
Total	50	100%

In this study, out of 50 patients, there were 13 (26%) patients each in the age group of 18 to 30 years and more than 60 years, and 12 (24%) patients each in the age group of 31 to 45 years and 46 to 60 years.

Table - 3: Acute Kidney Injury

AKI	Distribution(N=50)	
	Number	Percentage
Yes	28	56%
No	22	44%
Total	50	100 %

In the present study 28 (56%) patients developed AKI

Table -4: Comparision Of Raise In Sr. Creatinine Levels And Sr. Cystatin C Levels From Admission To 2nd Reading Among Patients With AKI

Criteria(Percentage Raise)	Sr.Creatinine (N=28)		Sr.Cystatin C (N=28)	
	No	%	No	%
R	11	39.2	0	0
I	15	53.5	16	57.1
F	2	7.1	12	42.8
Total	28	100	28	100

In the present study among patients who developed ARF 39.29%, 53.57% and 7.14% patients have satisfied R_{Creat} (50 to 99%), I_{Creat} (100 to 199%) and F_{Creat} (≥ 200%) criteria respectively. Among patients with category R_{Creat} rise of Sr. cystatin C was ≥ 100% and 57.14% patients had 100 to 199% rise in Sr. cystatin C levels and among 42.86% patients a rise of more than or equal 200% was noted.

Table - 5: Comparision Of Accuracy Of Sr. Creatinine And Sr. Cystatin C

	Sr. Creatinine		Sr. Cystatin	
	1st Reading (%)	2nd Reading(%)	1st Reading(%)	2nd Reading(%)
Sensitivity	0	78.5	85.7	100
Specificity	100	100	95.4	100
PPV	0	100	96	100
NPV	44	78.5	84	100

In this study the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) of Sr. Creatinine for first reading was 0%, 100%, 0%, 44% respectively and the sensitivity, specificity, PPV, NPV for first reading of Sr. Cystatin C was 85.71%, 95.45%, 96% and 84% respectively.

The sensitivity, specificity, PPV, NPV of Sr. Creatinine for second reading was 78.57%,100%,100%,78.57% respectively and the sensitivity, specificity, PPV, NPV for second reading of Sr. Cystatin C was 100%.

DISCUSSION:

In a study conducted by Hoste et al[7]Sr. Creatinine proved a very insensitive screening test for the early detection of renal dysfunction in ICU patients.A desirable biomarker of renal dysfunction should be rapidly and accurately measurable,applicable across a wide range of disease states,unaffected or atleast predictably affected by age,sex and ethinicity and be an early indicator of a change in GFR. pCysC has been identified as a surrogate marker of GFR in patients with various renal diseases and in patients with chronic renal insufficiency. PCysC has also been shown to be a more sensitive marker than pCr for the estimation of GFR in patients with diabetes mellitus

CONCLUSION:

In our study of 50 ICU patients, 28 patients developed Acute Renal Failure during the hospital stay. The first reading of Sr. Cystatin C in patients with AKI was high in significant number of patients where as the first reading of Sr. Creatinine was normal in all the patients with AKI indicating that Sr. Cystatin C is a early marker of AKI. Further the second reading of sr. Creatinine in patients with AKI was normal in 6 patients that is inspite of ≥ 50% rise in sr. Creatinine where as the second reading of Sr. Cystatin C was high in all patients with AKI. The percentage raise of Sr. Cystatin C was significantly greater than percentage raise of Sr. Creatinine in patients with AKI. This study concludes that Sr. Cystatin C is a early and more reliable marker of AKI than Sr. Creatinine in critically ill patients.

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