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Original Research Article

Microalbuminuria as an indicator of sepsis and to predict mortality in patients admitted in intensive care unit

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ABSTRACT

Background: Sepsis remains a major cause of morbidity and mortality worldwide. Early recognition is critical, but conventional diagnostic methods such as culture require more than 24 hours, delaying targeted therapy. Microalbuminuria, a marker of systemic endothelial dysfunction and capillary leak, may provide a rapid and non-invasive predictor of outcome. Objective of this study was to assess the role of microalbuminuria in predicting mortality among patients with sepsis admitted to the intensive care unit (ICU).
Methods: This prospective observational study was conducted in the ICU of Travancore Medical College, Kollam, from August 2022 to January 2024. A total of 122 adult patients with sepsis were enrolled after applying inclusion and exclusion criteria. Spot urine samples were collected within 6 hours of admission (ACR1) and at 24 hours (ACR2) to measure the albumin–creatinine ratio (ACR). The change in ACR (ΔACR = ACR1-ACR2) was calculated. Associations of ACR values with mortality and ICU stay were analysed using non-parametric tests, correlation studies, and ROC curve analysis.
Results: ACR2 was significantly higher among non-survivors than survivors (mean 284.3 vs. 77.0, $p<0.001$). Survivors showed a significant decline in ACR between 6 and 24 hours, while non-survivors had a significant increase. ΔACR correlated negatively with ICU stay duration ($\rho = -0.303$, $p<0.001$). ROC analysis identified ΔACR ≤21.5 as the optimal cutoff for predicting mortality, with sensitivity 83.9%, specificity 86.9%, and accuracy 86.2%.
Conclusions: Serial measurement of urine ACR, particularly ΔACR, within the first 24 hours is a simple, rapid, and cost-effective predictor of mortality in sepsis and can be especially valuable in resource-limited settings.

Keywords: Sepsis, Microalbuminuria, Mortality

INTRODUCTION

Persistent albumin excretion between 30 and 300 mg/day (20 to 200 mcg/min) is called moderately increased albuminuria, which is the new terminology for what was formerly called 'microalbuminuria'. The normal rate of albumin excretion is less than 30 mg/day (20 mcg/min).[1] Above 300 mg/day (200 mcg/min), albumin excretion is considered as severely increased albuminuria, which is the new terminology for what was formerly known as 'macroalbuminuria', overt albuminuria, or dipstick-positive albuminuria.[2]

Transient albuminuria is seen in exercise, fever, heart failure.[1] Moderately increased albuminuria suggests early diabetes, hypertension, early stages of glomerulonephritis (especially with RBCs, RBC casts).[1]

The filtration of anionic macromolecules (e.g., albumin) through the glomerular capillary wall is restricted by size- and charge-selective properties.[6] Subjects with moderately

increased albuminuria show both an increase in the number of large pores affecting size selectivity and decreased staining for heparan sulphate, the primary component of the charge barrier.[6] These defects become increasingly noticeable as overt albuminuria develops.[6]

24-hour urine collection was initially the gold standard for detecting moderately increased albuminuria, and urine albumin from an early morning sample was a preferred screening test.[1] An albumin excretion rate below 20 mcg/min in a timed collection or urine albumin concentration less than 20 to 30 mg/l in a random specimen is considered to be normal.[1] Urine albumin-to-creatinine ratio in an untimed urinary sample is the now the preferred screening test for moderately increased albuminuria.[4] It is easy to perform and feasible, and with good repeatability.[8] This minimises the influence of variations in urine volume on urine albumin concentration.[5] Moderately increased albuminuria is defined by a value of 30 to 299 mg/g of creatinine or 3.4 to 34 mg/mmol of creatinine in SI units. Severely increased albuminuria, previously termed to as macroalbuminuria is defined by values above 300 mg/g or 34 mg/mmol.[1,4]

Sepsis exists on a continuum of severity ranging from infection and bacteremia to sepsis, severe sepsis and septic shock, which can lead to multiple organ dysfunction syndrome (MODS), multiple system organ failure (MSOF), and death.[11] Systemic inflammatory response syndrome (SIRS) is a systemic manifestation of sepsis, or else the body's systemic response to severe infection.[11] SIRS is any two of: (1) hyperthermia (>38°C) or hypothermia (<36°C); (2) tachycardia (>90/min, no beta-blockers) or tachypnea (>20/min); (3) white cell count >12 × 10%/lite or <4 × 10%/litre.[5] Sepsis is SIRS with a documented infection.[5] Pathophysiologically, sepsis is characterised by uncontrolled systemic inflammatory responses and widespread damage to the microvascular endothelium with increased vascular permeability to plasma protein triggered by inflammatory mediators.[11]

Early diagnosis of sepsis is crucial for effective patient management and outcomes, as timely initiation of appropriate therapy can be life-saving.[3] The isolation of the causative organism from the culture of appropriate body fluids or tissue is the gold standard for the diagnosis of sepsis. However, it usually takes more than 24 hours, causing delay in the initiation of specific treatment which consequently impacts outcome. For this reason, the search for early markers of sepsis remains ongoing.[12]

The host defence in sepsis activates potent inflammatory cascades which releases multiple pro-inflammatory molecules into the circulation.[1] The endothelium thus becomes dysfunctional due to the sustained oxidative stress.[1] Loss of barrier integrity, leading to systemic capillary leak, is an early event. The glomerular manifestation of this leaky capillary is increased excretion of albumin in the urine.[1,4] Therefore, the severity of changes in systemic vascular permeability may be indirectly reflected by levels of microalbuminuria.[1,4]

Research question

Is there any relationship between microalbuminuria and sepsis, and can it predict mortality, of patients in sepsis admitted to intensive care units in TMC, Kollam?

Relevance

Sepsis poses a significant healthcare challenge in both India and globally due to its high morbidity and mortality rates, despite advancements in medical therapeutics.[23] Frequent delays in diagnosis compromise the efficacy of targeted therapies.[24] Early diagnosis of sepsis is critical for patient management and outcomes, as timely initiation of appropriate therapy can be life-saving.[3] The gold standard investigation for sepsis remains the isolation of the causative organism in culture from appropriate body fluids or tissues, a process that typically takes more than 24 hours.[8] This delay in identifying the pathogen can delay the initiation of targeted therapy, consequently impacting patient outcomes. Therefore, the search for early markers of sepsis continues. Serial monitoring of bedside urine albumin-creatinine ratio helps in the early recognition of sepsis.[2,4]

In India, where sophisticated and costly diagnostic tools pose challenges, effective determination and monitoring of optimal treatment and patient mortality are paramount. Microalbuminuria serves as a cost effective and rapid diagnostic tool, particularly beneficial in resource-limited areas.[12-14]

ICU survival is predicted by the assessment of the 24-hour albumin-to-creatinine ratio (ACR) and its potential to monitor the efficacy of therapeutic interventions, such as fluid resuscitation, appropriate antibiotics, vasopressors, and inotropes that affect the endothelium.[9,10] Therefore, our current study aims to evaluate the role of microalbuminuria in predicting mortality among critically ill patients. The primary objective of the study was to find out the relationship of microalbuminuria in patients admitted in intensive care unit with sepsis. Also, to estimate the ability of microalbuminuria in predicting mortality in critically ill patients in sepsis.

METHODS

Study design and setting

This was prospective study conducted at Intensive care unit, Travancore Medical College, Kollam.

Study period

The study was conducted for a period of 18 months after ethics committee clearance. August 2022 to January 2024.

Sample size

The sample size was calculated with reference to the study conducted by Nawal et al[1]

$N = Z21\text{-}\alpha/2 \times p \times (1\text{-}p)/d^2$

Where; Z1-α/2 - two tailed probability for 90% confidence interval = 1.64, p (%) - prevalence of microalbuminuria = 0.8, d (%)- precision or allowable error for microalbuminuria = 0.05

N = 1.64^2×0.87×(1-0.87)/0.05^2

N = 122.4

Thus, the total sample size required for the study is 122.

Inclusion criteria

All the patients admitted in Medical Intensive Care Unit (ICU) with age >15 years provisionally diagnosed as sepsis, with a duration of ICU stay for more than 24 hours were included.

Exclusion criteria

Patient with anuria, macroscopic haematuria. History of pre-existing chronic kidney disease (CKD) (patients on renal replacement therapy, sonologic evidence of chronic damage, or glomerular filtration rate of <30 ml/min). Menstruation and pregnancy. Patients with macroalbuminuria due to renal and post renal causes. New infection after 48 hours of ICU admission, i.e., nosocomial infection will be excluded. Known case of long-term uncontrolled diabetes mellitus and systemic hypertension.

Data collection method

Data was collected after getting informed written consent from patient/bystander, and were be filled in by the investigator using a pre-tested structured questionnaire.

Statistical analysis

The collected data were coded and entered into an Excel spreadsheet, then statistically analyzed using IBM SPSS Statistics, Version 26.0. Descriptive statistics were presented as means with standard deviations, or medians with interquartile ranges (IQR), for continuous variables. Categorical variables were summarized as frequencies and percentages. Graphical representation, such as bar charts and pie charts, was employed where appropriate for data visualization. The normality of variable distributions was assessed using the Kolmogorov-Smirnov normality test.

Data comparisons for continuous variables utilized appropriate statistical tests. Mann-Whitney U tests were employed for non-normally distributed data when comparing two groups. Chi-squared tests were used for categorical data comparisons. Fisher's Exact test was substituted when the expected frequency in contingency tables was <5 for >25% of cells. Spearman's rank correlation coefficient was used for non-normally distributed data when assessing correlations between two variables. Wilcoxon signed-rank tests were applied for paired comparisons due to non-parametric data.

ROC curve analysis was conducted to determine the optimal cutoff value of ΔACR as a predictor of mortality among survived and expired patients. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated for this cutoff.

Variables showing statistical significance in univariate analysis were included in binary logistic regression to identify significant risk factors associated with mortality. Univariate regression analysis was performed to assess the predictive contribution of each variable, with Z scores calculated for quantifying prediction strength. A significance level of $p<0.05$ was used throughout the statistical analyses.

Ethics committee clearance

Ethics committee clearance was obtained before the conduct of the study. Strict confidentiality of the data collected was maintained and was not be disclosed to anybody without prior permission from the patient/bystander. Participants were not burdened with any expenses related to the study's objectives.

Methods

To quantify the albumin-creatinine ratio (ACR), spot urine samples were collected within 6 hours of admission (referred to as ACR1) and again at 24 hours (referred to as ACR2). These samples were received and stored in biochemistry lab until analysis. Microalbuminuria is characterised by ACR values between 30 and 299 mg/g, while ACR >300 mg/g indicates clinical proteinuria, and ACR <30 mg/g is considered normal for a healthy population.

The trend of microalbuminuria was assessed by comparing the change in ACR values from ACR1 to ACR2. The difference (Δ ACR = ACR1 - ACR2) was calculated to evaluate the significance of Δ ACR in predicting mortality among sepsis patients. This study aims to determine the predictive value of Δ ACR in patient outcomes.

RESULTS

Patient demography and outcome variables of 122 patients after applying inclusion and exclusion criteria are summarised in Table 1.

Comparison of ACR1, ACR2 and ΔACR between survived/expired patients were conducted by Mann-

Whitney U tests and the results revealed that ACR2 was significantly high with expired patients (mean: 284.32 vs.76.97, p<0.001) compared to survived ones whereas no such significant difference showed with ACR1 as p=0.118. Wilcoxon signed rank tests were conducted to find out any significant difference in ΔACR among survived and expired patients and it determined that while ACR was significantly reduced from 6 to 24 hrs with survived ones (mean: 155.6 vs.76.97, p<0.001), it significantly increased in expired ones (mean:182.65 vs. 284.32, p<0.001). Mann-Whitney test confirmed that difference of ACR between the survived and expired ones were statistically significant too (p<0.001).

Table 1: Descriptive statistics of study subjects.

Variables	Survived				Expired				Total			
	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum	Mean	Std. Deviation	Minimum	Maximum
Age (years)	45.15	12.658	22	80	64.35	9.214	41	80	49.73	14.455	22	80
HbA1C	6.6846	0.13445	6.4	6.9	6.7607	0.12573	6.4	6.9	6.7366	0.13183	6.4	6.9
Temperature	100.706	0.7085	98.7	104	100.871	1.0351	98.7	104	100.745	0.7972	98.7	104
Heart rate	102.14	23.72	42	130	107.71	7.807	90	130	103.47	21.149	42	130
Respiratory rate	24.95	4.964	12	35	21.42	4.064	14	33	24.11	4.984	12	35
Total count	10010	5945.889	1500	21000	14374.19	4130.938	1900	23000	11050.69	5857.632	1500	23000
C-reactive protein	56.19	28.678	8	120	37.84	29.179	6	115	51.82	29.739	6	120
Serum creatinine (baseline)	1.01	0.1351	0.7	1.4	1.061	0.1667	0.7	1.2	1.022	0.1443	0.7	1.4
Serum creatinine (after 24 hrs)	1.049	0.1574	0.7	1.6	1.303	0.4637	0.8	3	1.11	0.2839	0.7	3
ACR1	155.62	69.516	34	298	182.65	68.132	38	290	162.06	69.889	34	298
ACR2	76.97	50.887	8	220	284.32	96.48	102	550	126.42	109.546	8	550
Δ ACR	80.53	51.008	-40	211	-90.9	120.059	-383	69	40.66	102.682	-383	211
Duration of stay in ICU	4.86	2	2	10	10	1.789	6	12	6.08	2.936	2	12

Table 2: Comparison of ACR1, ACR2 and Δ ACR between survived/expired.

ACR	Survived (n=99)			Expired (n=31)			
	Mean	SD	Median (IQR)	Mean	SD	Median (IQR)	P value
ACR 6 hrs	155.62	69.516	166 (90-220)	182.65	68.132	210 (123-220)	0.118
ACR 24 hrs	76.97	50.887	66 (31-128)	284.32	96.48	280 (210-343)	<0.001*
P value	<0.001*			<0.001*			
Δ ACR (ACR 6 hrs-ACR 24 hrs)	80.53	51.008	90 (48-109)	-90.9	120.059	-91 (-179 -8)	<0.001*

*Significant

Table 3: Comparison of duration of stay in ICU (days) between survived / expired.

Variables	Survived (n=99)		Expired (n=31)		P value
	Median	IQR	Median	IQR	
Duration of stay in ICU (days)	4	3-6	10	8-12	<0.001*

*Significant; Test: Mann-Whitney

Table 4: Duration of ICU stay and ACR.

Correlations	Correlation coefficient (ρ)	P value
Duration of stay in ICU vs. Δ ACR	-0.303	<0.001*

*Significant

Spearman bivariate correlations were conducted and significant low negative correlation showed between duration of stay in ICU and Δ ACR (Correlation coefficient (ρ)=-0.303, p<0.001).

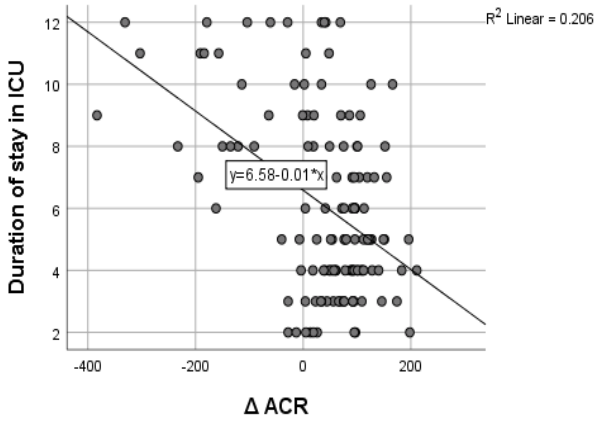

Figure 1: Negative correlation between duration of stay in ICU and Δ ACR.

Table 5: Area under the curve. Test result variable: Δ ACR.

Area	Std. error	Asymptotic sig.	Asymptotic 95% confidence interval	
			Lower bound	Upper bound
0.941	0.021	<0.001	0.9	0.981

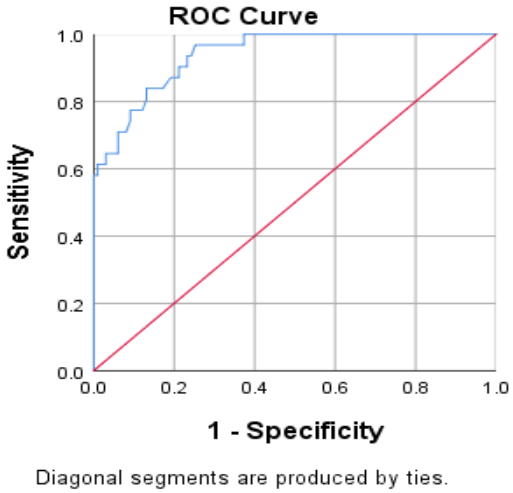

Figure 2: ROC curve analysis.

Table 6: Comparison of cut off categories of Δ ACR between survived/expired.

Δ ACR	Survived (n=99)	Expired (n=31)	Total (n=130)	P value
<=21.5	13 (13.1%)	26 (83.9%)	39 (30%)	<0.001*
>21.5	86 (86.9%)	5 (16.1%)	91 (70%)	

*Significant

To calculate the best possible cut off value of Δ ACR for the significant predictor of mortality, ROC curve analysis was done with the survived/expired patients. By Receiver Operator Curve of Δ ACR 21.5 (AUC:0.941, p<0.001), was calculated as the most accurate cut off point (sensitivity 83.9%, specificity 86.9%, PPV=66.7%, NPV=94.5%, accuracy=86.2%) equal or below which, the patient had the risk of mortality.

DISCUSSION

This study highlights several potential applications for urine albumin measurement in critically ill patients. Early diagnosis of sepsis is crucial for effective patient management and outcomes. While culture of body fluids remains the gold standard, it does not always yield timely results, often taking 24 hours or more. This delay in obtaining culture results may impede the timely administration of targeted therapies, underscoring the necessity for alternative diagnostic approaches like urine albumin measurement. There are several markers that have been used conventionally to identify sepsis. Several conventional markers have been utilized for identifying sepsis. Procalcitonin (PCT) is recognized for its sensitivity and specificity in systemic infections, yet it can also increase in non-infectious inflammatory conditions and may remain normal in localized infections.[25,26] C-Reactive Protein (CRP) is another marker used in sepsis, but it is nonspecific, takes time to increase, and does not consistently correlate with the severity of the disease.[25-29] In contrast, microalbuminuria levels rise within hours of inflammatory injury, presenting a potentially more rapid and sensitive indicator compared to PCT and CRP13.

In our study, we investigated the change in urine albumin levels following ICU admission and its correlation with patient outcomes. Comparison of ACR1, ACR2, and ΔACR between survived and expired patients (Table 1) revealed significant findings. ACR2 was notably higher in expired patients (mean: 284.32 vs. 76.97, p<0.001) compared to those who survived, whereas ACR1 did not show a significant difference (p = 0.118).

Further analysis indicated significant differences in both ACR1 and ACR2 between survived and expired patients. ACR decreased significantly from 6 to 24 hours in survived patients (mean: 155.6 vs. 76.97, p<0.001), whereas it increased significantly in expired patients (mean: 182.65 vs. 284.32, p<0.001). The difference in ACR values between survived and expired patients was statistically significant (p<0.001).

These findings suggest that changes in urine albumin levels early in the course of ICU admission may serve as a valuable predictor of patient outcomes in critically ill individuals.

Similar results were obtained in studies conducted by Nawal et al, Surupa et al, Gopal et al.[1,15,19] After 24 hours, the decrease in median ACR2 could be attributed to the

impact of therapeutic interventions on the inflammatory process, which helps protect the glycocalyx layer and prevent an increase in capillary permeability. This suggest that microalbuminuria can serve not only as a diagnostic tool but also as a means to assess the effectiveness of treatment in sepsis. Singh et al used microalbuminuria to assess the effect of N-Acetyl cysteine and Hydrocortisone in severe sepsis.[30,31] Similar results observed by Terao et al indicate that early targeted interventions may aid in preserving the glycocalyx, potentially mitigating increases in vascular permeability.[18]

Our study compared gender differences between survived and expired patients, and the results showed that gender was not statistically significant, with a p value of 0.977 (Table 2). Similar results were seen in study by Surupa et al.[19]

In our study, a significant weak negative correlation was observed between the duration of ICU stay and Δ ACR, with a correlation coefficient (ρ) of -0.303 and a p-value <0.001 (Table 4). Similar results were seen in studies conducted by Tayeh et al.[32]

The optimal cutoff value of Δ ACR for predicting mortality was determined using data from survived and expired patients in our study (Table 5). The most accurate cutoff point identified was Δ ACR ≤21.5, with a sensitivity of 83.9%, specificity of 86.9%, positive predictive value (PPV) of 66.7%, negative predictive value (NPV) of 94.5%, and overall accuracy of 86.2%. The area under the curve (AUC) for this cutoff was 0.941, with a p-value of less than 0.001, indicating strong predictive capability. Therefore, patients with a Δ ACR value of 21.5 or below were identified as having an increased risk of mortality based on our findings. Similar findings were found in studies done in past by Nawal et al, Basu et al and Bhadade et al.[1,9111,12] Indeed, the ability of Δ ACR to predict mortality can be explained similarly: an increasing trend in Δ ACR tends to indicate a poorer outcome, while a decreasing trend suggests a better outcome. This logic underscores the utility of Δ ACR as a dynamic marker that reflects changes in albumin excretion over time, providing valuable prognostic information in patients with sepsis. Abid et al and Bhadade et al similarly reported higher mortality rates among patients with high levels of microalbuminuria.[9,13]

Nawal et al conducted a study on “microalbuminuria: as an indicator of sepsis and to predict mortality in patients admitted to intensive care unit”. And they found that in comparison to APACHE II and SOFA scores, microalbuminuria demonstrates the highest sensitivity of 90% and specificity of 98% in distinguishing between sepsis and non-sepsis, with significantly higher levels observed in septic patients.[1]

Bhadade et al studied “microalbuminuria: a biomarker of sepsis and efficacy of treatment in patients admitted to a medical intensive care unit of a tertiary referral center”.[9] Significantly higher levels of microalbuminuria were observed among patients with sepsis compared to those without sepsis, as evidenced by the results and conclusions. In survivors with sepsis, these levels decreased after 24 hours, whereas they remained largely unchanged among non-septic patients. The change in microalbuminuria levels over 24 hours can serve as an indicator of therapeutic effectiveness. Persistence of high levels or an increasing trend of microalbuminuria over this period was identified as a predictor of poor outcomes. Importantly, both a high level of microalbuminuria at 24 hours and an increasing trend were found to predict mortality more effectively than APACHE II and SOFA scores.[9]

Saeed et al conducted a study on “Urine albumin/creatinine ratio as an early predictor of outcome in critically ill patients with sepsis”. And the conclusions were urinary ACR is a simple, rapid, non-invasive, cost effective, and early to perform and interpret test for early diagnosis and prediction of mortality in patients with sepsis. Late ACR after 24 h from ICU admissions and ACR trend overtime are more important than earlier admission ACR. Measurement of ACR on admission to ICU and 24 h later together with conventional illness severity scores can provide more informative data on patient outcome.[4]

Selvagambeer et al conducted a study on “study of microalbuminuria in sepsis with special reference to SAPS II score in a tertiary critical care center”. The conclusion drawn was that the degree of microalbuminuria was higher among patients with organ dysfunction compared to those without. Significant microalbuminuria was indicative of multi-organ dysfunction. Even in resource-poor areas, serial measurements may aid in the clinical assessment of critically ill patients at risk of a poorer prognosis2. Bhattacharya et al conducted a study on “prevalence and prognostic value of microalbuminuria in critically ill patients: a hospital-based study from northeast India”. The results were in-hospital mortality was higher in patients having microalbuminuria at admission than those without (48.6% vs. 40.0%). Microalbuminuria levels showed rising trend in non-survivors. In predicting mortality, the degree as well as the increasing trend in microalbuminuria shows significant correlation with scoring systems (APACHE II and SOFA), underscoring its potential as an important prognostic tool in critically ill patients.[8]

Tayeh et al conducted a study on “critically ill septic patients, urinary albumin/creatinine ratio as an early predictor of outcome." The conclusion indicates that this ratio could serve as a straightforward, rapid, non-invasive, cost effective, and easily interpretable test for early prognosis and mortality prediction in septic patients. Measurements of ACR taken 24 hours after ICU admission and the trend in ACR over time may be more crucial than the initial admission ACR. Therefore, combining ACR measurements with conventional illness severity scores

upon ICU admission and 24 hours later can provide additional insights into patient outcomes.[10]

Basu et al studied on "microalbuminuria: a novel biomarker of sepsis". The results showed absence of microalbuminuria upon ICU admission is unlikely to be associated with sepsis and strongly predicts ICU survival, on par with the APACHE II scores.[12]

Omar et al conducted a study on "mortality prediction of microalbuminuria in septic patients". The conclusion was ACR is a good prognostic marker in septic patients and could be utilized as a mortality predictor, especially in early (within 6 hours) septic patients. Twenty percent of enrolled patients died within 28 days of hospital admission. ACR ≥ 40 mg/g creatinine was identified as the cutoff point for predicting mortality. ACR was significantly higher in non-survivors compared to survivors (55.1±20.5 vs. 30.2±35.7, p=0.006), with a sensitivity of 90.7% and specificity of 71.8%. The total accuracy was 66%, and the AUC was 0.75 (CI 0.62-0.88).[6]

Patil et al conducted a study on "urinary albumin-creatinine ratio as a predictor of outcome in patients who are critically ill". The conclusion was albumin-creatinine ratio at 24 hours predicted the outcome. Patients without microalbuminuria during the first 6 hours of ICU admission are less likely to have sepsis. At 24 hours, albumin-creatinine ratio is predictive of ICU survival, equivalent to APACHE II, SOFA score.[5]

Basu et al conducted a study on "microalbuminuria: a feasible, non-invasive bedside tool to predict outcome". The conclusion was ACR had a sensitivity of 69%, specificity of 67%, positive predictive value of 31%, and negative predictive value of 91% for predicting mortality in critically ill patients. A significant microalbuminuria at 24 hours predicts ICU survival.[11]

Our study has few limitations. While conditions like uncontrolled diabetes mellitus and hypertension are known independent causes of microalbuminuria in the general population, excluding these conditions would have made our study population less representative of real-life scenarios. Additionally, excluding critically ill patients with chronic kidney disease limits the applicability of microalbuminuria as a diagnostic tool in all critically ill populations. These limitations highlight the need for further research to validate the findings across diverse patient groups and clinical settings.

CONCLUSION

Our study highlights several potential applications of measuring microalbuminuria in sepsis patients. Assessing Urine ACR2 and Δ ACR can predict ICU survival and duration of ICU stay. Additionally, these measurements have the potential to monitor the effectiveness of therapeutic interventions such as fluid resuscitation, selection of antibiotics, vasopressors, and inotropes, which impact the endothelium. Another potential application is the early identification of high-risk patients within 24 hours of admission.

Microalbuminuria emerges as a cost effective and rapid diagnostic tool. Conducting serial measurements could significantly enhance the clinical evaluation of critically ill patients, particularly those at risk of poor prognosis in resource-limited settings. Therefore, quantifying the amount of albumin excreted in a random urine sample, ACR, remains a simple, cost-effective, validated, and reliable test.

This underscores the potential of microalbuminuria as a valuable tool in the management and prognostication of sepsis patients, advocating for its integration into clinical practice to improve patient outcomes.

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