PREDICTIVE VALUE OF PLATELET-TO-ALBUMIN RATIO FOR ACUTE KIDNEY INJURY IN PATIENTS WITH DECOMPENSATED CIRRHOSIS: A DOUBLE-CENTER STUDY

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This study aims to evaluate the value of the platelet-to-albumin ratio (PAR) in predicting acute kidney injury (AKI) in patients with decompensated cirrhosis. A descriptive cross-sectional analysis was conducted at multiple centers on 295 patients with decompensated cirrhosis, treated at the Department of Gastroenterology - Can Tho Central General Hospital and the Department of Gastroenterology - Bac Lieu General Hospital from June 2019 to May 2021. The results showed that the average age of the study subjects was 60.0 ± 12.5 years old, with a male/female ratio of 3/2. The average albumin level was relatively low, at 27.18 ± 6.29 g/L. The median platelet count was 73 x 10^9/L. The median platelet-to-albumin ratio was 2.99. The incidence of acute kidney injury in patients with decompensated cirrhosis was 33.9%. At a cut-off point of the serum platelet-to-albumin ratio ≥ 3.64, the predictive value for the incidence of acute kidney injury in patients with decompensated cirrhosis was recorded with an area under the ROC curve (AUC) of 96.7% (95%CI: 95% - 98%).

Keywords: Platelet-to-albumin ratio, predictive value, acute kidney injury, decompensated cirrhosis.

I. INTRODUCTION

Cirrhosis is one of the leading causes of death among chronic liver diseases, accounting for 2.4% of global deaths in 2019.[1] The burden of the disease has become increasingly severe due to rising alcohol consumption along with hepatitis B and C infections. Notably, acute kidney injury occurs in 60% of patients hospitalized for cirrhosis, further increasing the risk of mortality and complicating treatment.[2] Therefore, early diagnosis and timely treatment of this condition are of utmost importance. However, traditional biomarkers used by clinicians to assess kidney damage, such as creatinine and urea, face several limitations, including the influence of external factors such as muscle mass, muscle metabolism, and diet – factors that are particularly common in cirrhotic patients.[3] Against this backdrop, the platelet-to-albumin ratio, a recently emerging indicator, has shown potential in monitoring inflammation and nutritional status.[4] This ratio also has the ability to predict poor prognosis in various conditions, including kidney injury.[5] Therefore, our study was conducted with the aim of evaluating the value of the PAR in predicting AKI in patients with decompensated cirrhosis.

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II. MATERIALS AND METHODS

1. Subjects

All patients with decompensated cirrhosis treated at the Department of Gastroenterology – Can Tho Central General Hospital and Bac Lieu General Hospital from June 2019 to May 2021.

Inclusion criteria

- Patients were diagnosed with

decompensated cirrhosis according to the 2018 European Association for the Study of the Liver criteria when presenting with at least one of the following manifestations[6]: (1) ascites, (2) jaundice, (3) acute hepatic encephalopathy, (4) gastrointestinal bleeding due to esophageal varices rupture, or (5) hepatorenal syndrome.

- Patients were aged 18 years or older, regardless of gender.
- Patients consented to participate in the study.

Exclusion criteria

- Patients with kidney failure due to obstructive causes.
- Patients who had undergone liver or kidney transplantation.
- Patients who had previously undergone dialysis.
- Patients with concomitant malignant diseases.

2. Methods

Study design

A cross-sectional, double-center study.

Sample size

A convenient sample, all patients with decompensated cirrhosis 0…32 that met the inclusion criteria and did not meet any exclusion criteria during the study period. In practice, we selected 295 suitable subjects and followed until the end of the study.

Study contents

General characteristics: Age (years, mean; < 40, 40 - 59, ≥ 60), gender (male/female), Child-Pugh classification (A, B, C).[7]

Platelet-to-albumin ratio: Which is determined by dividing the platelet (PLT) count (10^9/L) by the serum albumin concentration (g/L).

Incidence of AKI. Patients were diagnosed with AKI according to the 2015 ICA criteria: An increase in serum creatinine ≥ 0.3 mg/dL (26.5 µmol/L) within 48 hours or an increase in serum creatinine ≥ 50% compared to baseline serum creatinine.[3,8] The baseline serum creatinine is now defined as a stable serum creatinine obtained within the previous 3 months. If no recent serum creatinine is available, the serum creatinine closest to the current value is used. If serum creatinine has never been measured, the serum creatinine at hospital admission is used, and it is assumed that AKI occurred within the past 7 days.

Statistical analysis

Data was processed and analyzed using SPSS 26.0 software. The values of qualitative variables are presented as frequencies or percentages. The values of quantitative variables are presented as mean, standard deviations if normally distributed, or median, quartile if not normally distributed. The Receiver Operating Characteristic (ROC) curve is used to identify the PAR cut-off point with the highest sensitivity and specificity for predicting incidence of AKI. The accuracy is represented by the area under the ROC curve. The results are represented in table and chart forms.

3. Research ethics

The study was approved by the Biomedical Research Ethics Committee of Can Tho University of Medicine and Pharmacy, Can Tho Central General Hospital and Bac Lieu General Hospital with approval No. 1025/QĐ-ĐHYDCT dated 1 January 2019 and No. 23.277.HV.PCT-HĐĐĐ dated 12 April 2023.

III. RESULTS

In studying 295 patients diagnosed with decompensated cirrhosis at Can Tho Central General Hospital and Bac Lieu General Hospital, we obtained the following results.

Table 1. General characteristics

Characteristics		n	%
Age	< 40	15	5.1
	40 - 59	126	42.7
	≥ 60	154	52.2
	Mean ± SD	60.0 ± 12.5	
Gender	Male	180	61.0
	Female	115	39.0
Child-Pugh classification	A	1	0.3
	B	150	50.8
	C	144	48.9

The majority of the subjects were male, aged 40 and above (94.9%), with 42.7% between the ages of 40-59 and 52.2% aged 60 and above. The average age was 60.0 ± 12.5 years old.

Table 2. Characteristics of platelet count, blood albumin, and PAR

Variables	Value
PLT (10^9/L), median (IQR)	73.00 (51.00 - 111.00)
Serum albumin (g/L), mean ± SD	27.18 ± 6.29
PAR (10^9/g), median (IQR)	2.99 (1.80 - 3.97)

The average albumin level was 27.18 ± 6.29 g/L. The median platelet count was 73 x 10^9/L, and the platelet-to-albumin ratio was 2.99.

The incidence of AKI accounted for more than one-third of the total study subjects (33.9%).

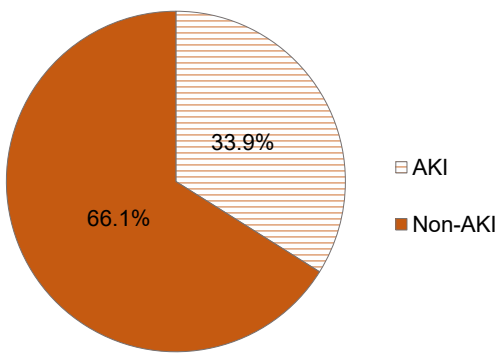

Chart 1. The incidence of acute kidney disease

Table 3. Incidence of Acute Kidney Injury Among Child-Pugh Groups and Cirrhosis Complications

Variables		AKI, n (%)	Non-AKI, n (%)	p-value
Child-Pugh classification	A	0 (0.0)	1 (100)	0.357†
	B	46 (30.7)	104 (69.3)	
	C	54 (37.5)	90 (62.5)	
Ascites	Yes	93 (41.2)	133 (58.8)	< 0.001*
	No	7 (10.1)	62 (89.9)	
Hepatic encephalopathy	Yes	19 (61.3)	12 (37.8)	< 0.001*
	No	81 (30.7)	183 (69.3)	
Variceal bleeding	Yes	30 (34.9)	56 (65.1)	0.819*
	No	70 (33.5)	139 (66.5)	

†Fisher-Freeman-Halton Exact Test
**Pearson Chi-Square*

The incidence of acute kidney injury was higher in patients with ascites and hepatic encephalopathy, with a statistically significant difference ($p < 0.001$).

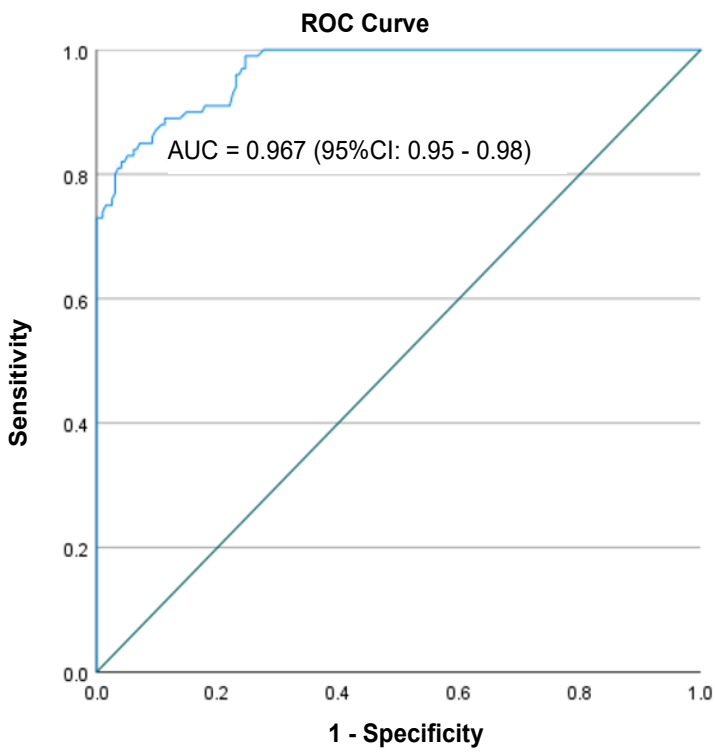

Chart 2. The predictive value of the serum PAR

At a cut-off point of PAR ≥ 3.64, the predictive value for the incidence of AKI in patients with decompensated cirrhosis was recorded with an AUC of 96.7% (95%CI: 95% - 98%).

IV. DISCUSSION

Our study, conducted on 295 patients with decompensated cirrhosis and AKI, with the majority being male and having an average age of 60, mostly Child-Pugh B-C cirrhosis, found that over one-third of the subjects were diagnosed with AKI. The serum platelet-to-albumin ratio has proven to be a useful biomarker with good predictive potential in this particular group.

In fact, we recorded that 33.9% of decompensated cirrhosis patients had AKI, a relatively higher proportion than in some previous studies. Specifically, Vo Thi My Dung reported a rate of 19.1%, Ngo Thi Yen Nhi recorded 25.6%, and Thapa and colleagues found 18.5%.[9-11] This discrepancy may be due to various influencing factors, including patient age, the progression stage of cirrhosis, or accompanying comorbidities. These factors contributed to the variability in the incidence of AKI among patients with decompensated cirrhosis across different studies. Nevertheless, AKI is not uncommon in cirrhosis patients, emphasizing the need for early prognostic methods and treatment to reduce the risk of further progression. Simultaneously, upon further analysis, we observed a higher rate of acute kidney injury in patients with ascites and hepatic encephalopathy, with a statistically significant difference, which has also been consistently observed in previous studies.[9,10] Although an individual's risk of developing AKI varies depending on multiple associated factors, consensus holds that complications from decompensated cirrhosis are among the critical precipitating factors, necessitating preventive strategies alongside other factors such as existing liver and kidney conditions, comorbidities, and additional causes like nephrotoxic drug use and hypovolemia...[2]

In our study, the platelet-to-albumin ratio demonstrated a very good predictive ability for AKI in patients with decompensated cirrhosis, with an area under the ROC curve (AUC) of 96.7% (95%CI: 95% - 98%). The platelet-to-albumin ratio is a biomarker combining two common tests, platelets and albumin, reflecting the overall imbalance in liver function and circulation. In cirrhosis, there is not only a decrease in platelets due to portal hypertension and reduced albumin synthesis, but there is also interaction between these factors in regulating blood supply to other organs. The platelet-to-albumin ratio allows for the assessment of the degree of impairment in this regulatory ability, making it valuable for predicting complications across multiple organs, rather than focusing on just one system. Indeed, the platelet-to-albumin ratio has previously been studied for predicting certain conditions.[4,12] In comparison to previous studies, Zhai and colleagues, when analyzing two different databases, also found PAR's predictive ability for persistent AKI in ICU patients, with an AUC of 0.726 (95%CI: 0.714 - 0.739) and 0.744 (95%CI: 0.722 - 0.766).[5] One key factor contributing to PAR's predictive value for AKI in cirrhotic patients is its ability to reflect two major risk factors for kidney damage: poor microcirculation due to reduced platelets and loss of colloid pressure due to low albumin. The kidneys, heavily dependent on perfusion and colloid pressure to maintain filtration function, become especially vulnerable to this change. When PAR is high, it indicates that both factors – circulatory dysfunction (due to low platelets) and reduced colloid pressure (due to low albumin) – are occurring simultaneously,

creating an environment conducive to AKI. Compared to other predictive parameters, Patidar's AKI prediction model, though more complex as it uses INR, white blood cells, and creatinine, had a lower predictive outcome with an AUC of 0.77 (95%CI: 0.70 - 0.83).[13] This shows that PAR is not only a good predictive marker but also has the advantages of simplicity and easy clinical application. Furthermore, in terms of practicality, for hospitalized cirrhotic patients, platelet and albumin tests are basic indicators for assessing cirrhosis status. This makes determining the platelet-to-albumin ratio straightforward and convenient for clinicians.

Although this is a double-center study, we must acknowledge that our study's biggest limitation is the relatively small sample size, and it is only a descriptive cross-sectional analysis on a specific group of acute decompensated cirrhosis patients. Additionally, predictive ability was only evaluated by discrimination as reflected by the AUC, without evaluation of calibration or internal and external validation, as done in other prognostic models. Therefore, larger-scale studies with deeper subgroup analyses across multiple populations are needed to validate the predictive value of this index.

V. CONCLUSION

Our study results preliminarily show that the platelet-to-albumin ratio has good predictive potential in predicting acute kidney injury in patients with decompensated cirrhosis.

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