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ARTICLE

Whether serum albumin/leukocyte ratio combined with Go-FAR score more accurately predicts the neurological outcome of patients who suffered cardiac arrest

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Abstract

Objective: To investigate whether serum albumin/leukocyte ratio combined with good outcome score after resuscitation (GO-FAR score) can improve the prediction of neurological outcomes in patients with cardiac arrest, so that clinical decisions can be made earlier and futile resuscitation can be avoided. **Methods:** The main research outcome was the neurological outcome within one month after cardiac arrest. The brain function performance score (CPC score) was used for assessing neurological outcomes, It was divided into two groups:a good prognosis group (CPC score 1-2) and a poor prognosis group (CPC score 3-5). Multivariate Logistic analysis and ROC curve analysis were performed on the data of the two groups, and conclusions were drawn. **Result:**Univariate and multivariate analysis found that the albumin/leukocyte ratio and GO-FAR score in the poor prognosis group were lower than those in the good prognosis group, and the difference between the two groups was statistically significant ($P < 0.05$). Malignant tumor, shock rhythm, albumin, and leukocytes were all influencing factors for functional outcomes in patients with cardiac arrest.

Keywords: cardiac arrest;albumi;leukocyte;GO-FAR Score

1. Background

Sudden cardiac arrest (CA) is a sudden, devastating disease process. Survival and neurological outcomes are our constant focus. The global incidence of out-of-hospital cardiac arrest (OHCA) is 55-88/100000[2].Despite continuous improvements in mechanical, technical and pharmaceutical interventions, patient survival after cardiac arrest remains poor[1].Causes more deaths in the United States than many cancers, metabolic diseases, and even car accidents. Despite such a heavy death burden, CPR has been successful in restarting the heart

after cardiac arrest, resulting in a survival rate of approximately 10% for CA after discharge. While current advanced resuscitation citation methods, including hypothermia and extracorporeal membrane oxygenation, improve patient survival, they are unlikely to further significantly improve national survival rate without pattern transfer. The focus of CA rescue includes: 1.Restoring autonomic heart rhythm as soon as possible;2. Restoring brain supply as soon as possible to minimize the occurrence of ischemic-hypoxic encephalopathy.Currently, discharge survival rates for patients who have experienced OHCA are 10.4% and 11.4% for adults and children, respectively, while discharge rates for hospitalized cardiac arrest (IHCA) patients are 25.8% and 41.1% for adults and children, respectively[3]With either OHCA or IHCA, the likelihood of survival and the chance of a good neurological outcome is low[4].Several risk models have been published to address CPR directives. However, evidence to support clinical decision-making remains scarce[5]A systematic review of available prognostic models for predicting outcomes of IHCA resuscitation attempts was conducted, using pre-arrest factors to enhance clinical decision-making by improving outcome predictions[6].A meta-analysis found that[6]Among several published predictive models of clinical outcomes after IHCA resuscitation, the GO-FAR score is the only prognostic model with good performance in multiple external validation studies, but there is moderate bias. At present, although there is an analysis of the predictive value of individual scores at home and abroad, there is no study on whether albumin/leukocyte ratio combined with GO-FAR score has better predictive value. This trial intends to investigate whether albumin/leukocyte ratio combined with GO-FAR score can better predict neurological outcomes in patients with cardiac arrest.

2. Materials and Methods

2.1 Study design and population

The data of 72 patients with cardiac arrest (both in and out of hospital) were collected, including age, gender, underlying diseases (malignancy, hypertension, coronary heart disease, kidney disease), whether there was a sighted cardiac arrest, whether the heart rhythm can be electrocuted, serum leukocytes, albumin, and resuscitation time before cardiac arrest occurred. The GO-FAR score (see Table 1) and albumin/leukocyte ratio were calculated according to the collected data. The main study outcome was the neurological outcome one month after cardiac arrest, and the secondary study outcome included the influencing factors affecting the neurological outcome of cardiac arrest patients. The neurological outcome score was divided into a good neurological outcome group (n = 11) and an adverse outcome group (n = 61) according to the CPC score.

2.2 Inclusion and exclusion criteria

Inclusion criteria: over 18 years old; patients with sudden cardiac arrest in the hospital or sudden cardiac arrest outside the hospital recover ROSC after rescue (the standard for restoring ROSC refers to the recovery of autonomous circulation time lasting more than 20 minutes).

Exclusion criteria: Patients who died despite ROSC recovery; patients undergoing in vitro ECMO support; including patients receiving hospice care and pregnant; missing data;

Table 1 Go-FAR Score

Variables	Score
Neurologically intact at admission	-15
Major trauma	10
Acute stroke	8
Metastatic or hematologic cancer	7
Septicemia	7
Medical non-cardiac diagnosis	7
Hepatic insufficiency	6
Admission from skilled nursing facility	6
Hypotension or hypoperfusion	5
Renal insufficiency including dialysis	4
Respiratory insufficiency	4
Pneumonia	1
Age (years)	
70–74	2
75–79	5
80–84	6
≥85	11

(Note: The GO-FAR score divides the likelihood of survival after CPR with good neurological function into four grades: very low (< 1%), low (1% -3%), moderate (3% -15%), above average (> 15%).

patients who abandoned rescue.

2.3 Statistical methods

The normality test was performed on the two groups of data, both of which were in line with the normal distribution. Qualitative data were displayed as frequency and percentage, while quantitative data were displayed as $x \pm s$. Chi-square test was used to compare the categorical variables of each group. Continuous variables were compared between groups. Statistical significance was obtained with $P < 0.05$. Multivariate logistic regression analysis was used. The results of regression analysis were expressed in OR. The area under the ROC curve (AUC) was used to assess the predictive value of albumin/leukocyte, GO-FAR score, albumin/leukocyte + GO-FAR Score.

3. Results

3.1 Univariate analysis of quantitative and qualitative data

Among the 72 patients with cardiac arrest, a total of 11 had good prognosis and outcome, of which 9 had good brain performance. 62 patients had adverse neurological outcomes, 35 died one month after cardiac arrest, and 27 were in deep coma.Univariate analysis of all data showed that there were statistically significant differences in malignancy, shock heart rhythm, GO-FAR score, white blood cells, albumin, and albumin/white blood cell ratio

between the two groups ($P < 0.05$). It can be considered that cardiac arrest patients with combined malignancy, low GO-FAR score, low albumin level, high white blood cell level, and non-shock heart rhythm had worse neurological outcomes. (See Table 2, Table 3)

Table 2 Univariate analysis of qualitative data

Variables		Neurological outcome		p
		Poor prognosis group	Good Prognosis group	
Gender[n(%)]	Male	46（75.4）	6（54.5）	0.291
	Female	15（24.6）	5（45.5）	
hypertension[n(%)]	Yes	29（47.5）	4（36.4）	0.722
	No	32（52.5）	7（63.6）	
diabetes[n(%)]	Yes	8（13.1）	3（27.3）	0.456
	No	53（86.9）	8（72.7）	
Malignant tumor[n(%)]	Yes	34(55.7)	2（18.2）	0.049
	No	27（44.3）	9（81.8）	
Renal failure[n(%)]	Yes	7（11.5）	1（9.1）	1.000
	No	54（88.5）	10（90.9）	
Heart disease[n(%)]	Yes	13（21.3）	3（27.3）	0.965
	No	48（78.7）	8（72.7）	
shockable rhythm[n(%)]	Yes	19（31.1）	8（72.7）	0.022
	No	42（68.9）	3(27.3)	
Witnessed collapse[n(%)]	Yes	34（55.7）	9（81.8）	0.197
	No	27（44.3）	2（18.2）	
Go-FAR Score[n(%)]	Extremely Low	10（16.4）	1（9.1）	0.028
	Low	15（24.6）	1（9.1）	
	Moderate	34（55.7）	6（54.5）	
	Above average	2（3.3）	3(27.3)	

Table 3 Single factor analysis of quantitative data

Variables	Poor prognosis group	Good Prognosis group	t	P
Age	54.15±19.248	58.18±13.325	-0.665	0.508
Time of resuscitation	62.31±22.310	41.73±16.560	1.041	0.301
White blood cell(WBC)	13.353±5.064	9.223±3.810	2.571	0.012
Albumin(ALB)	31.003±6.954	35.686±7.529	-2.031	0.046
ALB/WBC	2.754±1.489	4.555±2.399	-3.332	0.001

3.2 Multivariate logistic regression analysis

The results suggest that electric shock heart rhythm, GO-FAR score, and albumin/leukocyte value were statistically significant between the two groups (P < 0.05) (see Table 4).

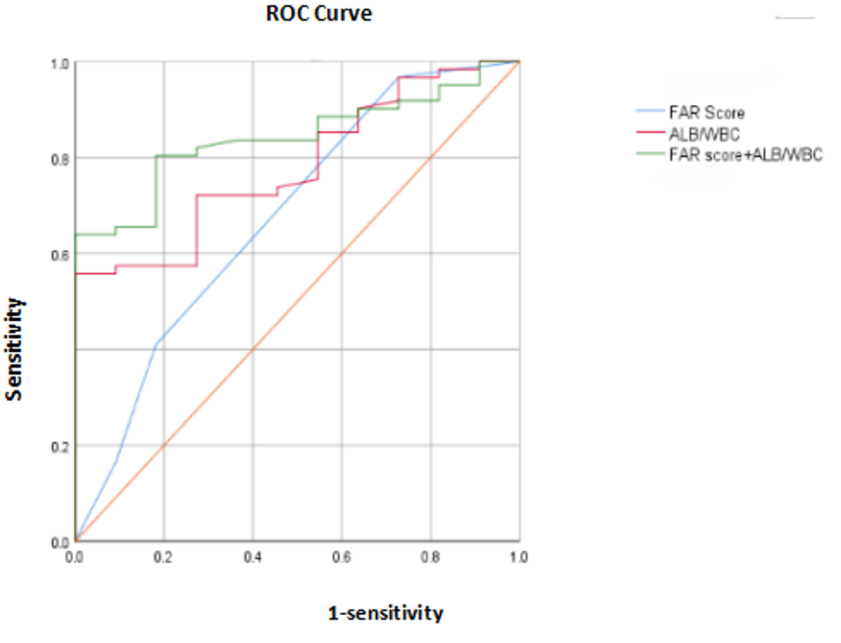
Table 4.Multivariate logistic regression analysis

	B	S.E.	Wald	p	OR
Malignant tumor	1.286	.961	1.790	0.181	3.619
shockable rhythm	-1.635	.863	3.595	0.048	0.195
GO-FAR Score	1.337	.614	4.738	0.030	3.807
ALB/WBC	.478	.185	6.659	0.010	1.613
Albumin(ALB)	.067	.091	.543	0.461	1.069
White blood cell(WBC)	-.170	.257	.437	0.509	0.844

3.3 Predictive value of ALB/WBC, GO-FAR score, ALB/WBC + GO-FAR score for neural outcomes (see Figure 1)

The area under the curve of ALB/WBC, GO-FAR score, and ALB/WBC + GO-FAR score respectively were: 0.782 (95% CI: 0.662 to 0.903), 0.677 (95% CI: 0.493 to 0.862), 0.841 (95% CI: 746-0.936), the difference was statistically significant (P < 0.05). It can be concluded that the predictive value of ALB/WBC + GO-FAR score is higher.

Figure 1 ROC curve



4. Discussion

Sudden cardiac arrest is a sudden, high-mortality disease, and resuscitation and survival outcomes are not significantly improved after a lot of effort and financial investment. Ideally, clinicians would be able to identify patients with a good qualitative chance of survival after CPR, as well as patients with a low chance of survival, where futile resuscitation attempts can be avoided.Several risk models have been published to address CPR directive issuance and prognosis prediction. Indicators include the pre-arrest morbidity (PAM) index[7],Post-Resuscitation Prognosis (PAR) Score and Good Outcome Score System after Attempted Resuscitation (GO-FAR)[8]and ABCD scoreAge, weight, comorbidities, date of admission).

[9]Although studies have evaluated the predictive value of GO-FAR scores in patients with in-hospital cardiac arrest, most have a moderate risk of bias and have not been externally validated. This study found that albumin/leukocyte ratio, GO-FAR score were independent risk factors for adverse outcomes in patients with cardiac arrest. Combination of both may have better predictive value.In addition to risk prediction models, studies have also found independent predictive value of individual indicators for patients with cardiac arrest.Hong Shi ren et al. found[10]that albumin levels before cardiac arrest were independently associated with neurological outcomes.The predictive performance of the original GO-FAR model improved when albumin levels were combined with ordered scales. A foreign study found[11]Higher serum albumin concentrations are strongly associated in a dose-dependent manner with favorable neurological outcomes in patients with out-of-hospital cardiac arrest undergoing CPR. A prospective, multicenter study found that not only validated the predictive value of albumin for prognosis, but also concluded that the lactate/albumin ratio (LAR) was significantly associated with favorable neurological outcomes and discharge survival in patients with out-of-hospital cardiac arrest[12].Several studies have suggested that human serum albumin has a protective effect, low serum albumin is associated with mortality and morbidity in critically ill patients, and human serum albumin has anti-inflammatory properties and a protective effect on reducing ischemia-reperfusion injury[13].This study found that albumin levels in the good prognosis group were higher than those in the poor prognosis group, and the difference was statistically significant, which is consistent with the above findings. However, the predictive value of individual items is limited. In addition, studies have found that elevated white blood cell levels may only be a non-causal risk marker for adverse outcomes, but white blood cells are involved in reperfusion injury due to their size and capillary obstruction, and tissue damage is caused by the release of oxygen free radicals and the release of the proteolytic enzyme elastase, which ultimately leads to ischemic hypoxic encephalopathy[14].However, data supporting the prognostic value of leukocytes are scarce and inconsistent. A retrospective cohort study found [15]that there were no differences in PCT, CRP, or WBC levels among survivors at admission and non-survivors after hypothermia treatment in cardiac arrest patients and at all days of follow-up.A randomized controlled study found [16]that total white blood cell count and neutrophil levels measured on the first day after OHCA were significantly associated with 180-day all-cause mortality and may serve as early predictors of outcomes. However, leukocyte and neutrophil levels did not significantly improve the predictive value of multivariate models with known outcome risk markers[17].This study analyzed the predictive value of albumin/leukocyte ratio, GO-FAR score, and the combination of the two for adverse outcomes in patients with cardiac

arrest. Univariate analysis found that the albumin/leukocyte ratio of the poor prognosis group (2.754±1.489) was lower than that of the good prognosis group (4.555±2.399), and the comparison of GO-FAR scores between the two groups was statistically significant.Through ROC analysis, it was found that the area under the ROC curve of the combination of the two was 0.841, and its predictive value was higher than that of albumin/leukocyte ratio and GO-FAR score. Therefore, the neurological outcomes of patients with cardiac arrest can be predicted by calculating the albumin/leukocyte ratio and GO-FAR score. If adverse neurological outcomes are considered, family members can be informed of the condition and prognosis as soon as possible to avoid futile cardiopulmonary resuscitation.

This study has certain limitations. First of all, the sample size in this study is small, and although the data are in line with the normal distribution, there are few data with good prognosis. In addition, the study did not distinguish patients with out-of-hospital cardiac arrest from in-hospital cardiac arrest in this paper, and the results of the study may be biased. In short, more clinical studies are needed to confirm the conclusions drawn so far.

NOTE

Xiaojing MAO is the first author and Wenbin YANG is co-first author.

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