Short Communication

Expression of Hemoglobin and Fibrinogen is Correlated with the Attack of Acute Arterial Embolism of the Lower Extremity

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ABSTRACT

The objective of this study was to analyze the expression of hemoglobin and fibrinogen in acute lower extremity arterial embolism and its correlation with acute lower extremity arterial embolism. One hundred and twenty patients with acute lower extremity arterial embolism diagnosed and treated in Qinghai Provincial People's hospital from January 2020 to January 2022 were selected as the study group, and 120 healthy people examined in Qinghai Provincial People's hospital in the same period were selected as the control group. The levels of hemoglobin and fibrinogen in the two groups were analyzed, and then the correlation between the levels of hemoglobin and fibrinogen and acute lower extremity arterial embolism was analyzed. It was found that the level of hemoglobin in the control group was significantly higher than that in the study group, and the level of fibrinogen was significantly lower than that in the study group. Compared with grade I patients, patients with grade II, III and IV acute lower extremity arterial embolism had lower hemoglobin and higher fibrinogen. There was significant difference between the four groups ($P<0.05$); Hemoglobin and fibrinogen showed negative correlation in acute lower extremity arterial embolism ($r = 14.970$, $P = 0.001$); Serum hemoglobin was negatively correlated with acute lower extremity arterial embolism ($r = -0.529$, $P = 0.001$), and fibrinogen was positively correlated ($r = 0.637$, $P = 0.001$). Compared with the diagnostic value of single item detection of hemoglobin and fibrinogen in acute lower extremity arterial embolism, combined detection has higher diagnostic value in acute lower extremity arterial embolism ($P<0.05$). It is concluded, with the progress of the disease, the level of hemoglobin gradually decreased and fibrinogen gradually increased. And there is a correlation between them and lower extremity arterial embolism.

Detachment of embolism in heart or arteries could result in the blockage of vessels by embolism or plaque, which could further give rise to the arterial embolism, thereby causing the circulatory disturbance or even ischemic diseases (Liu *et al*., 2020). Given the clinical data, anomaly usually rises in the affected limb after the attack of embolism in veins of lower limbs, which could further result in the irreversible damage to the limbs or even amputation or death in some severe cases (Chen *et al*., 2021; Adams *et al*., 2020).

Hemoglobin, as a protein that is able to transport oxygen and turn the color of red blood cells into red, is constituted mainly by heme and globin. According to the clinical research, any increases or decreases in hemoglobin show the clinical significance in indicating the changes of red blood cells (Schweblin *et al*., 2020). It has already been shown that hemoglobin is closely related to the development and progression of arterial embolism, but there remains little evidence suggesting the correlation between the expression profile of hemoglobin and the acute arterial embolism of lower extremity (Meng *et al*., 2021). Fibrinogen, as coagulation factor I, plays a pivotal role in the coagulation. Existing clinical data have shown that fibrinogen in plasma is a quite important and independent

risk factor for arterial embolism diseases (Liu *et al*., 2020), which, however, has yet been proved in fewer studies.

In this study, to provide some clinical references for early detection, diagnosis and timely treatment of acute arterial embolism of lower limbs, we enrolled the patients with acute arterial embolism of lower extremity to extract the supernatant to detect the levels of hemoglobin and fibrin, aiming to analyze the correlation between the expression of hemoglobin and the attack of acute arterial embolism of lower extremity.

Materials and methods

A total of 120 patients with acute arterial embolism of lower extremity who were diagnosed and treated in Qinghai Provincial People's Hospital between January 2020 and January 2022 were enrolled into the research group, and simultaneously, 120 healthy people who received the physical examination in this hospital into the control group. In the research group, there were 78 males and 42 females, aged between 45 and 62 years old, with an average of 53.5±6.8 years; in the control group, there were 77 males and 43 females, aged between 44 and 61 years old, with an average of 52.5±6.8 years. Comparison of the general data of subjects between two groups showed no significant differences, suggesting the comparability of patient's data between two groups. For all patients, ultrasonic examination was performed, and according to the results, patients were categorized into 4 grades: Grade 1 (n= 16), Grade 2 (n= 23), Grade 3 (n= 29) and Grade 4 (n= 52). Besides, general data of patients, including the age, sex and site of attack, were also compared among four grades, showing no significant differences (P>0.05).

Inclusion criteria: Patients with the acute arterial embolism of lower extremity confirmed by ultrasonic examination and CTA, patients with the embolism affecting only one extremity within 24 h after attack and patients who and whose family signed the written informed consents were included in this study.

Exclusion criteria: Patients with severe insufficiency in heart or kidney, patients with the history of acute myocardial infarction within 6 months and patients with other vascular disorders were excluded.

Ultrasonic examination was performed for patients, and according to the results, patients were divided into four grades: Grade 1 for patients with the strong aching feeling or the impotence; Grade 2 for patients with no feeling at the affected site; Grade 3 for patients with the appearance of paralysis or stripes; Grade 4 for patients with the signs of muscular tension, necrosis, paralysis and the signs of exfoliation or blisters at the affected sites.

For index analysis, fasting venous blood (5 mL) was collected from all subjects, mixed with sodium citrate for anticoagulation, plasma and serum were separated by high-speed centrifugation and centrifuged to obtain the supernatant, where the levels of hemoglobin and fibrinogen in serum were detected by using the enzyme-linked immunosorbent assay (ELISA), with the kits purchased from Wuhan Fine Biotech Co., Ltd., and all procedures were performed in strict accordance with the instructions of kits.

SPSS 25.0 software was utilized to perform the data analysis. Measurement data were first subjected to the test of variance homogeneity by levene method and the test of normal distribution by shapiro-wilk test, were expressed in form of mean ± standard deviation (SD). Differences in measurement data were testified through the analysis of variance of repeated measured data, while the comparison for the data of the same timepoint was performed by the independent sample *t* test. F value was also calculated for the comparison among groups. Pearson method was also carried out for the correlation analysis between the levels of hemoglobin and fibrinogen and the attack of acute arterial embolism of lower extremity. *P*<0.05 suggested that the difference had statistical significance.

Results

Figure 1A shows the increased level of hemoglobin in the subjects is suffering from acute arterial embolism whereas the level of fibrinogen showed the converse changes (*P* < 0.05).

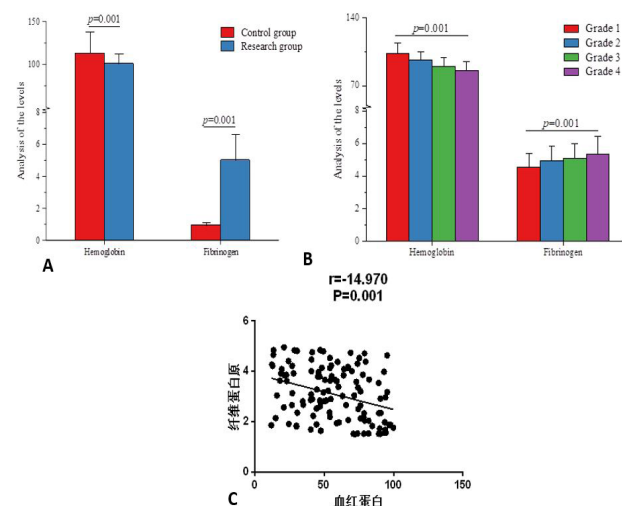
Fig. 1. Effect of acute arterial embolism on the extreme of hemoglobin and fibrinogen ($\bar{x}$±s), (g/L) in patients suffering from acute arterial embolism (A), different grades of embolism (B), and correlation of hemoglobin and fibrinogen (C).

Figure 1B shows that compared to the patients in grade 1, those in grade 2, 3 and 4 show lower levels of hemoglobin and higher levels of fibrinogen, and as disease progressed, hemoglobin showed a continuous decrease, while fibrinogen manifested the opposite changes (all $P<0.05$). A negative correlation was identified between the levels of hemoglobin and fibrinogen in acute arterial embolism of lower extremity ($r = 14.970$, $P = 0.001$, Fig. 1C).

The level of hemoglobin in serum was in a negative correlation with the acute arterial embolism of lower extremity ($r = -0.529$, $P = 0.001$), while fibrinogen in a positive correlation ($r = 0.637$, $P = 0.001$) (Table I).

We noted that in comparison with the diagnostic value of single application of hemoglobin or fibrinogen for acute arterial embolism of lower extremity, combined application showed a promising diagnostic value (all $P<0.05$) (Table II).

Table I. Analysis of the correlation of hemoglobin and fibrinogen with the acute arterial embolism of lower extremity.

Indexes	Acute arterial embolism of lower extremity	
	r	P
Hemoglobin	-0.529	0.001
Fibrinogen	0.637	0.001

Table II. Diagnostic value of hemoglobin and fibrinogen for acute arterial embolism of lower extremity.

Indexes	AUC	Z	P	Sensitivity (%)	Specificity (%)	95%CI
Hemoglobin	0.529	2.429	0.001	71.53	71.61	0.527-0.942
Fibrinogen	0.617	2.167	0.001	71.68	71.52	0.627-0.937
Combination	0.834	2.691	0.001	89.75	91.63	0.613-0.925

Discussion

Acute arterial embolism of lower extremity is mainly caused by the sudden, multifactorial interruption of arterial blood perfusion, which can further trigger the acute ischemia or hypoxia, or even other diseases. According to the clinical survey, pathogens are categorized into the arterial embolism and atherosclerotic thrombosis (Gong et al., 2021; Gottsäter, 2021). After the attack of acute arterial embolism of lower extremity, patients usually present the aches in limbs, anomaly in feelings or chills, and, in some cases, it may cause amputation or even death due to the rapid onset and progression (Boc et al., 2020).

As such, very early diagnosis and treatment in time are of great significance for improving the prognosis, decreasing the rate of amputation and death rate.

Hemoglobin, a protein existing specifically in red blood cells, is mainly constituted by the peptides of globin and heme, acting as a transporter of oxygen and carbon dioxide (Ren et al., 2020; Wu and Zhang, 2015). Ferrous ion is necessary in the synthesis of hemoglobin, and any insufficiency of ferrous ion could result in the anomaly in the synthesis of hemoglobin, which further gives rise to the symptoms of iron-deficiency anemia, thereby affecting the mental and physical wellbeing (Zhou et al., 2022; Li et al., 2021). Existing clinical survey has shown that hemoglobin is expressed abnormally in the diseases in vascular surgery, suggesting the potential correlation between them (Qi et al., 2021). As a common disease in vascular surgery, acute arterial embolism of lower extremity has been severely affecting the well-being of patients (Xue et al., 2021). In this study, we detected the serum of acute arterial embolism of lower extremity and found a decreasing trend in the level of hemoglobin, which further decreased as disease progressed, suggesting the close correlation between the level of hemoglobin and acute arterial embolism of lower extremity. Besides, we also found that the level of hemoglobin in serum was in a negative correlation with the acute arterial embolism of lower extremity.

Fibrinogen, a glycosylated protein synthesized and secreted by liver cells, is mainly constituted by three polypeptide chains which are encoded by three totally different genes (Ye and Gong, 2021; Wu et al., 2016). Clinical evidence has shown that the synthesis of Fg-Bβ chain is a critical step in synthesis of fibrinogen (Zhan et al., 2021). Existing data have shown that variations in the levels of fibrinogen represent a key and independent risk factor for the development of arterial embolism (Li et al., 2020). In this study, we also measured the level of fibrinogen in serum of patients and found that the level of fibrinogen presented an increasing trend, which would be enhanced as disease progressed, thereby verifying the intimate association between the serum level of fibrinogen and acute arterial embolism of lower embolism. Moreover, the level of fibrinogen was in a positive correlation with the development of acute arterial embolism of lower extremity.

This study also has limitations: the sample size included in this study is small and retrospective analysis, and the follow-up time is also short. It is expected to be further improved by expanding the sample size, carrying out prospective and central control studies, and extending the follow-up time.

Conclusion

  Hemoglobin showed low expression in acute lower extremity arterial embolism and fibrinogen showed high expression in acute lower extremity arterial embolism. With the progress of the disease, the level of hemoglobin gradually decreased and fibrinogen gradually increased. And there is a correlation between them and lower extremity arterial embolism.

Acknowledgement

  The advice and guidance of Ms. Su, Director of the Department, is gratefully acknowledged.

IRB approval

  This study was approved by the Advanced Studies Research Board of Qinghai Provincial People's Hospital, Xining, Qinghai 810007, China.

Ethical statement

  This study had been approved by the ethical committee of Qinghai Provincial People's Hospital.

Statement of conflict of interest

  The authors have declared no conflict of interest.

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