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CORRELATION ANALYSIS OF SERUM LAP, GDGF, AND FERRITIN IN THE PROGNOSIS OF ACUTE MYELOID LEUKEMIA

KORELACIONA ANALIZA SERUMSKIH NIVOA LAP, GDGF I FERITINA U PROGNOZI AKUTNE MIJELOIDNE LEUKEMIJE

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Summary

Background: To look into the correlation analysis between blood levels of Latency-associated peptide (LAP), Glioma-derived growth factor (GDGF), ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio and the prognosis of patients with acute myeloid leukaemia (AML).
Methods: The study group consisted of 384 AML patients who were hospitalised at the Zhongshan Hospital Affiliated to Xiamen University and Nanjing Hospital of Chinese Medicine Affiliated to Nanjing University of Chinese Medicine between May 2020 and October 2024, whereas the control group was made up of 192 healthy people who were examined physically while they were there. The levels of serum LAP, GDGF, and ferritin and the neutrophil/lymphocyte ratio and albumin/fibrinogen ratio were compared. Patients with a favourable or poor prognosis were divided into two groups. The factors predicting prognosis in AML patients were examined using multivariate logistic regression and by comparing clinical data between the two groups. Receiver operating characteristic (ROC) curves were developed to evaluate the predictive significance of LAP, GDGF, neutrophil/lymphocyte ratio, albumin/fibrinogen ratio, and ferritin for the prognosis in AML patients.
Results: The GDGF level, ferritin, neutrophil/lymphocyte ratio, and albumin/ fibrinogen ratio were all higher than those in the control group ($P<0.05$), although the study group's serum LAP level was lower ($P<0.05$). Among the AML patients, 116 had a poor prognosis

Kratak sadržaj

Uvod: Cilj je bio da se ispita korelacija između nivoa u krvi latentno-asociranog peptida (LAP), faktora rasta poreklom iz glioma (GDGF), feritina, odnosa neutrofila i limfocita (NLR) i odnosa albumina i fibrinogena (AFR) i prognoze kod pacijenata sa akutnom mijeloidnom leukemijom (AML).
Metode: Ispitivanjem je obuhvaćeno 384 pacijenta sa AML koji su hospitalizovani u bolnici Zhongshan u sklopu Univerziteta u Sjamenu i u Bolnici tradicionalne kineske medicine u Nankingu, u sklopu Univerziteta kineske medicine u Nankingu, u periodu od maja 2020. do oktobra 2024. godine. Kontrolnu grupu su činile 192 zdrave osobe koje su u istim ustanovama obavile sistematski pregled. Upoređeni su nivoi serumskog LAP, GDGF i feritina, kao i odnos neutrofila i limfocita i odnos albumina i fibrinogena. Pacijenti su podeljeni u dve grupe: sa povoljnom prognozom i sa nepovoljnom prognozom. Faktori koji predviđaju prognozu kod pacijenata sa AML su analizirani primenom multivarijantne logističke regresije i poređenjem kliničkih podataka između dve grupe. Konstruisane su ROC krice radi procene prediktivne vrednosti LAP, GDGF, NLR, AFR i feritina za prognozu kod pacijenata sa AML.
Rezultati: Nivoi GDGF, feritina, NLR i AFR bili su vić i u odnosu na kontrolnu grupu ($P<0,05$), dok je nivo serumskog LAP u ispitivanoj grupi bio niži ($P<0,05$). Među pacijentima sa AML, 116 je imalo nepovoljnu prognozu (grupa sa nepovoljnom prognozom), a 268

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(poor-prognosis group), and 268 had a good prognosis (good-prognosis group). The poor-prognosis group had higher levels of GDGF, ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio ($P<0.05$), whereas the good-prognosis group had higher levels of serum LAP ($P<0.05$). Multivariate logistic regression analysis showed that elevated serum LAP levels were independent protective factors for prognosis in AML patients ($P<0.05$), while elevated serum GDGF and ferritin levels, along with elevated neutrophil/lymphocyte ratios and albumin/fibrinogen ratios, were independent risk factors for prognosis in AML patients ($P<0.05$). According to the ROC curve analysis, the areas under the curve (AUCs) for LAP, GDGF, ferritin, the neutrophil/lymphocyte ratio, and the albumin/fibrinogen ratio in predicting prognosis in AML patients were 0.747, 0.811, 0.804, 0.783, and 0.845, respectively.

Conclusion: Serum LAP levels are decreased in AML patients, whereas GDGF, ferritin, neutrophil/lymphocyte ratio and albumin/fibrinogen ratio levels are increased. Additionally, each of the aforementioned signs has some predictive value for the prognosis of individuals with AML and is an independent influencing factor.

Keywords: acute myeloid leukaemia, latency-associated peptide, neutrophil/lymphocyte ratio, albumin/fibrinogen ratio, glioma-derived growth factor

povoljnu prognozu (grupa sa povoljnom prognozom). Grupa sa nepovoljnom prognozom imala je viće nivoe GDGF, feritina, NLR i AFR ($P<0,05$), dok je grupa sa povoljnom prognozom imala viće nivoe serumskog LAP ($P<0,05$). Multivarijantna logistička regresiona analiza pokazala je da povićen nivo serumskog LAP predstavlja nezavisni zaćitni faktor prognoze kod pacijenata sa AML ($P<0,05$), dok povićeni nivoi GDGF i feritina, kao i pović eni NLR i AFR, predstavljaju nezavisne faktore rizika za prognozu kod pacijenata sa AML ($P<0,05$). Prema analizi ROC krivih, povrćine ispod krive (AUC) za LAP, GDGF, feritin, NLR i AFR u predviđanju prognoze kod pacijenata sa AML iznosile su 0,747; 0,811; 0,804; 0,783 i 0,845.

Zaključak: Kod pacijenata sa AML snižen je nivo serumskog LAP, dok su nivoi GDGF, feritina, NLR i AFR povićeni. Svaki od navedenih pokazatelja ima određenu prediktivnu vrednost za prognozu kod pacijenata sa AML i predstavlja nezavisni faktor uticaja.

Ključne reči: akutna mijeloidna leukemija, latentno-asocirani peptid, odnos neutrofila i limfocita, odnos albumina i fibrinogena, faktor rasta poreklom iz glioma

Introduction

The most prevalent form of leukaemia in adults, acute myeloid leukaemia (AML), is a malignant condition caused by aberrant proliferation of primitive and immature cells in the bone marrow (1–3). Its main clinical symptoms include anaemia, bleeding and infection, which can lead to a severe decline in the body's hematopoietic function and cause lesions in multiple organs (4). At present, in clinical practice, for AML, chemotherapy, hematopoietic stem cell transplantation and targeted therapy are mainly used to alleviate the condition of patients effectively. Still, the long-term survival rate remains relatively low (5–7). Therefore, scientifically predicting the prognostic risk of AML patients at the early stage of diagnosis is necessary to guide improvements in patient prognosis (8).

TGFβ1 and LAP are essentially different manifestations of the same molecular system. TGFβ1 is an important cytokine that regulates cell growth, differentiation, and immune responses. In the body, TGFβ1 mainly exists in an inactive form and forms a complex with LAP (latent associated peptide) through non-covalent bonds. LAP is a part of the TGFβ1 precursor and is linked to the mature TGFβ1 during synthesis, keeping it in an inactive state. This inactive form prevents premature activation of TGFβ1 and ensures its proper functioning at the appropriate time and location.

Studies (9–11) have shown that the latency-associated peptide (LAP) can regulate hematopoiesis, promote fibroblast development and repair, and inhibit tumour cell proliferation. Glioma-derived growth factor (GDGF) is closely associated with tumour blood vessel regeneration and tissue growth (12). The neutrophil/lymphocyte ratio and the albumin/fibrinogen ratio are both systemic indicators of inflammation (13). Relevant reports (14–16) have shown that the neutrophil/lymphocyte ratio has diagnostic value for childhood AML, whereas the albumin/fibrinogen ratio is associated with the prognosis of various cancers. Ferritin is an iron-containing protein. Relevant studies (17–19) have shown that its serum level is associated with disease status in children with acute leukaemia. However, the relationships between the LAP, GDGF, neutrophil/lymphocyte ratio, albumin/fibrinogen ratio, ferritin levels and the prognosis of AML patients remain unclear (20).

Thus, the purpose of this study was to investigate the associations between the prognosis of AML patients and their neutrophil/lymphocyte ratio, albumin/fibrinogen ratio, serum LAP, GDGF, and ferritin to provide a theoretical foundation for the prognostic evaluation of AML patients.

Materials and Methods

General information

The study group consisted of 384 AML patients who were admitted to Zhongshan Hospital, Affiliated to Xiamen University, and Nanjing Hospi-

tal of Chinese Medicine, Affiliated to Nanjing University of Chinese Medicine, between May 2020 and October 2024.

Inclusion criteria: (1) Diagnosis of AML in accordance with relevant AML standards, combined with clinical manifestations, imaging examination results, laboratory test indicators, etc.; (2) Age ≥18 years; (3) Complete clinical data; (4) First diagnosis of AML and no relevant treatment received before admission; (5) No previous history of tumors.

Exclusion criteria: (1) Major organ failure, such as heart, liver or kidney failure; (2) Pregnancy or breastfeeding; (3) Autoimmune system diseases or other hematological system diseases; (4) Communication barriers, comprehension barriers or the inability to complete relevant checks as needed; (5) Other infectious diseases or obvious tissue damage; (6) Poor compliance or dropout during the follow-up process.

There were 204 males and 180 females in the research group, with ages ranging from 20 to 68 years and an average of 53.66±9.20 years. Educational attainment: 74 cases involved junior high school or below, 188 cases involved senior high school or junior college, and 122 cases involved a bachelor's degree or above. FAB classification: 38 cases of M0, 72 cases of M1, 108 cases of M2, 114 cases of M3, 30 cases of M4, and 22 cases of M5. Chromosomal karyotype: A total of 302 cases were normal, and 82 cases were abnormal.

Another 192 healthy individuals who underwent physical examinations in our hospital. In the control group. There were 84 females and 108 males, with an average age of 52.28±9.15 years. Educational attainment: 22 cases involved junior high school or below, 106 cases involved senior high school or junior college, and 64 cases involved a bachelor's degree or above. There were no statistically significant differences in sex, age or educational level (P>0.05).

This study was approved by the Medical Ethics Committee of the Zhongshan Hospital Affiliated to Xiamen University (HKYS-2026-A0263) and Nanjing Hospital of Chinese Medicine Affiliated to Nanjing University of Chinese Medicine (KY2025178). All research subjects provided informed consent for this study and signed the informed consent form.

Detecting the levels of serum LAP, GDGF and ferritin and calculating the neutrophil/ lymphocyte ratio and albumin/fibrinogen ratio

Three millilitres of fasting venous blood were collected from each patient in the control group on the morning after admission and on the day of physical examination. After standing at room temperature for 30 minutes, the mixture was centrifuged at 3,500 r/min for 10 minutes to separate the upper serum for later use. Three millilitres of fasting venous blood were collected via a Sodium citrate tube (blue cap tube), and routine blood and coagulation function indicator tests were completed within 2 hours.

Laboratory testing reagents and instruments

The haemoglobin level, platelet count, white blood cell count, neutrophil count, and lymphocyte count in the blood samples were measured using a blood analyser (Zibo Hengtuo Analytical Instrument Co., Ltd., model: BTX-2800), and the Neutrophil/ Lymphocyte ratio was calculated. Moreover, a blood coagulation analyser (Jiangsu Innova Medical Technology Co., Ltd., model: The fibrinogen level in blood samples was detected by a CL-2000. An enzyme-linked immunosorbent assay (ELISA) kit from Shanghai Future Industry Co., Ltd. was used to measure the serum levels of LAP, GDGF, and Ferritin. The serum ALB level was determined via the bromocresol green method (kit provided by Ningbo Ruiyuan Biotechnology Co., Ltd.), and the albumin/ fibrinogen ratio was calculated.

Follow-up investigation

After discharge, the research group conducted 1–2 follow-up visits per month via phone or WeChat or through outpatient re-examinations, to promptly assess patients' prognosis. Follow-up was conducted continuously for 12 months, and patients were informed that they would be admitted to the hospital uniformly 12 months after discharge for genetic testing and disease assessment. The follow-up endpoint event was the patient's death. Based on the relevant results, prognosis was divided into good and poor, and patients were accordingly assigned to the good- and poor-prognosis groups.

Prognostic assessment criteria

The AML risk stratification criteria released by the European Leukaemia Network (ELN) were primarily used for formulation.

A patient's prognosis is considered poor if any of the following conditions occur: (1) recurrence of the disease or death; (2) complex karyotypes or haploid karyotypes; (3) the wild-type NPM1 gene is present and is accompanied by a high level of FLT3-ITD; (4) there are mutations in the RUNX1 gene, ASXL1 gene or TP53 gene; (5) any one of the following gene mutations exists: DEK-NUP214 fusion gene, KMT2A gene rearrangement, BCR-ABL1 fusion gene or 3q26/MECOM gene rearrangement.

Statistical analysis methods

The statistical program SPSS 23.0 was used to analyse the data. When comparing two groups, an independent-samples t-test was employed, and normally distributed data are represented as $\bar{x}\pm s$. Count data are presented as percentages and counts, and the χ^2 test was used for group comparisons. Hierarchical data were compared using the rank sum test. Multivariate logistic regression was used to investigate the factors influencing the prognosis of AML patients. Receiver operating characteristic (ROC) curves were used to assess the prognostic value of LAP, GDGF, the neutrophil/lymphocyte ratio, the albumin/fibrinogen ratio, and ferritin in AML patients.

Results

Comparison of the LAP, GDGF, and ferritin levels, the neutrophil/lymphocyte ratio and the albumin/fibrinogen ratio between the study group and the control group

While the study group's serum LAP level was lower than the control group's ($P<0.05$), the levels of GDGF, ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio were all higher ($P<0.05$), see *Table I*.

There were significant differences in multiple indicators between the AML patient group and the control group. The levels of serum GDGF and ferritin, as well as the values of neutrophil/lymphocyte ratio and albumin/fibrinogen ratio in AML patients, were significantly higher than those in healthy controls, while the level of serum LAP was significantly decreased. This series of changes suggests that there are obvious microenvironment abnormalities in AML patients: the increase in GDGF may reflect abnormal interactions between stromal cells and leukaemia cells, and the increase in ferritin is related to iron metabolism disorders and inflammatory states. The increase in the neutrophil/lymphocyte ratio indicates a systemic inflammatory response and immune imbalance. Changes in the albumin/fibrinogen ratio are related to nutritional status and alterations in coagulation function. The decline of LAP may suggest its unique tumour-suppressor role in AML progression.

Clinical data comparison between the groups with a good and a poor prognosis

The follow-up rate was 100%, and no patients were lost to follow-up. According to follow-up data, 116 AML patients had a poor prognosis (poor-prognosis group), 268 had a good progno-

Table I Comparison of LAP, GDGF, ferritin levels and neutrophil/lymphocyte ratio, albumin/fibrinogen ratio between study group and control group ($\bar{x}\pm s$).

Group	n	LAP (pg/mL)	GDGF (pg/mL)	neutrophil/ lymphocyte ratio	albumin/ fibrinogen ratio	ferritin (ng/mL)
Research group	384	48.75±7.56	429.48±80.76	5.21±0.96	21.71±3.95	683.52±97.67
Control group	192	130.44±15.02	173.29±29.67	2.09±0.38	16.89±3.01	182.57±35.32
t		-61.344	30.077	32.763	10.740	48.673
P		<0.001	<0.001	<0.001	<0.001	<0.001

Table II Comparison of clinical data between the good prognosis group and the poor prognosis group.

Group	n	Gender		Age (years)	Educational level		
		Male	Female		Junior high school and below	High school and junior college	Bachelor's degree or above
Good prognosis group	268	136 (50.75)	132 (49.25)	52.88±9.10	44 (16.42)	138 (51.49)	86 (32.09)
Poor prognosis group	116	68 (58.62)	48 (41.38)	55.46±9.48	30 (25.86)	50 (43.10)	36 (31.04)
$x^2/t/Z$		1.001		-1.777	2.473		
P		0.318		0.071	0.294		

Continued Table II Comparison of clinical data between the good prognosis group and the poor prognosis group.

Group	n	Haemoglobin (g/L)	Platelet count ($\times10^9$/L)	White blood cell count ($\times10^9$/L)	Chromosome karyotype	
					Normal	Abnormal
Good prognosis group	268	89.61±7.82	52.26±9.90	9.69±1.30	218 (81.34)	50 (18.66)
Poor prognosis group	116	91.89±8.07	49.48±9.69	9.34±1.37	84 (72.41)	32 (27.59)
x^2/t/Z		-1.741	1.794	1.639	1.925	
P		0.085	0.078	0.107	0.169	
Group	n	FAB classification				
		M0	M1	M2	M3	M4	M5
Good prognosis group	268	20 (7.46)	56 (20.90)	84 (31.34)	90 (33.58)	10 (3.73)	8 (2.99)
Poor prognosis group	116	18 (15.52)	16 (13.79)	24 (20.69)	24 (20.69)	20 (17.24)	14 (12.07)
x^2/t/Z		1.423					
P		0.159					
Group	n	LAP (pg/mL)	GDGF (pg/mL)	neutrophil/ lymphocyte ratio	albumin/ fibrinogen ratio	ferritin (ng/mL)	
Good prognosis group	268	49.67±7.64	417.56±78.50	4.94±0.85	19.85±3.56	664.45±95.76	
Poor prognosis group	116	46.52±7.39	456.92±83.44	6.16±1.05	26.34±4.41	727.81±101.25	
x^2/t/Z		2.578	-3.139	-8.776	-10.757	-4.148	
P		0.014	0.002	<0.001	<0.001	<0.001	

sis (good-prognosis group), and the poor-prognosis rate was 30.24%. Serum LAP levels were greater in the group with a good prognosis than in the group with a terrible prognosis ($P<0.05$). Still, GDGF, ferritin, Neutrophil/Lymphocyte ratio, and albumin/fibrinogen ratio levels were higher in the poor-prognosis group ($P<0.05$). Sex, age, educational attainment, haemoglobin level, platelet count, white blood cell count, karyotype, and FAB typing did not differ significantly between the groups with excellent and poor prognoses ($P>0.05$; see *Table II*).

The levels of serum GDGF and ferritin, as well as the values of neutrophil/lymphocyte ratio and albumin/fibrinogen ratio in the poor prognosis group were significantly higher than those in the good prognosis group, while the level of serum LAP was significantly lower. These differences suggest that the high expression of GDGF and ferritin may be associated with disease progression, the elevated neutrophil/lymphocyte ratio reflects a more significant systemic inflammatory state, the changes in albumin/fibrinogen ratio indicate an imbalance between nutrition and coagulation, and the low level of LAP may be related to its impaired tumour suppressor function.

Variables impacting AML patients' poor prognosis by multivariate logistic regression

Multicollinearity tests were conducted on LAP, GDGF, ferritin, Neutrophil/Lymphocyte ratio, and albumin/fibrinogen ratio. The variance inflation factors (VIFs) were all less than 10, indicating no multicollinearity among the above indicators. The prognosis of AML patients (bad prognosis =1, good prognosis =0) was the dependent variable in a multivariate logistic regression analysis, whereas the independent factors were LAP, GDGF, ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio (all inputs with original values).

Table III Multivariate logistic regression analysis of factors affecting prognosis in AML patients.

Factor	β	SE	Wald x^2	P	OR	OR 95%CI
LAP	-0.547	0.164	11.459	0.001	0.583	0.427~0.798
GDGF	0.066	0.018	18.219	<0.001	1.068	1.038~1.099
Neutrophil/lymphocyte ratio	1.093	0.352	9.206	0.005	2.977	1.474~6.014
Albumin/fibrinogen ratio	0.442	0.113	16.581	<0.001	1.560	1.266~1.949
Ferritin	0.022	0.001	19.322	<0.001	1.022	1.019~1.046

Table IV The predictive power of serum LAP, GDGF, ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio for prognosis in AML patients.

Indicator	Best truncation value	AUC	AUC 95%CI	P	Sensitivity (%)	Specificity (%)	Youden index
LAP	46.70 pg/mL	0.747	0.679~0.807	<0.001	67.27	72.32	0.399
GDGF	423.68 pg/mL	0.811	0.759~0.873	<0.001	81.06	76.15	0.575
Neutrophil/lymphocyte ratio	5.39	0.783	0.718~0.830	<0.001	77.52	69.43	0.473
Albumin/fibrinogen ratio	23.94	0.845	0.786~0.894	<0.001	68.90	88.09	0.573
Ferritin	662.27 ng/mL	0.804	0.730 0.858	<0.001	79.34	71.67	0.513

Elevated levels of serum GDGF and ferritin, as well as elevated neutrophil/lymphocyte ratios and albumin/fibrinogen ratios, were independent risk factors for prognosis in AML patients ($P<0.05$). However, in AML patients, increased serum LAP levels were independent protective indicators of prognosis ($P<0.05$; see *Table III*). After adjusting for other clinical factors, serum LAP, GDGF, ferritin, the neutrophil/lymphocyte ratio, and the albumin/fibrinogen ratio were all significantly associated with the prognosis of AML. Among them, a higher level of serum LAP has been confirmed as an independent protective factor for the prognosis of AML patients, while increases in GDGF and ferritin levels, as well as in the neutrophil/lymphocyte ratio and albumin/fibrinogen ratio, have been identified as independent risk factors. This discovery reveals the complex mechanism of AML prognosis from multiple dimensions: LAP may exert a protective effect by regulating cell differentiation and apoptosis.

Predictive value of serum LAP, GDGF, ferritin, the neutrophil/lymphocyte ratio and the albumin/fibrinogen ratio for poor prognosis in AML patients

The state variable was the prognosis of AML patients (bad prognosis =1, excellent prognosis =0). The test variables included serum LAP, GDGF, ferritin, neutrophil-to-lymphocyte ratio, and albumin-to-fibrinogen ratio. The ROC curve was generated using these variables. LAP, GDGF, ferritin, the neutrophil/lymphocyte ratio, and the albumin/fibrinogen ratio were found to have areas under the curve (AUCs) of 0.747, 0.811, 0.804, 0.783, and 0.845, respectively, for predicting prognosis in AML patients (see *Table IV)*.

LAP, as a protective factor, may inhibit leukaemia progression by regulating the immune microenvironment. The increase in GDGF and ferritin is closely associated with pathological processes such as tumour proliferation and iron metabolism disorders. The neutrophil/Lymphocyte ratio serves as a systemic inflammatory marker, while the albumin/fibrinogen ratio comprehensively reflects nutritional status and coagulation function. Together, they represent the body's overall response to disease.

Discussion

AML accounts for more than 60% of all leukaemia cases (21). It is more prevalent in men than in women, and as patients age, the incidence rate rises (22–24). Research on the pathogenesis, bio-

logical characteristics, and prognostic mechanisms of AML has been increasing, and the number of drugs developed based on these mechanisms is also increasing. However, the clinical treatment of this disease still has many problems, such as a low cure rate, easy recurrence and poor drug tolerance, which generally leads to poor treatment effects (25–27). Therefore, identifying markers highly relevant to the condition and prognosis of AML patients is crucial for improving their outcomes.

Among tumour stromal cells, tumour-associated fibroblasts constitute the main cell population and an important component of the tumour microenvironment. These cells can accelerate tumour cell epithelial-mesenchymal transition (EMT) by secreting various inflammatory factors, including LAP, thereby promoting tumour cell invasion and metastasis. Some studies (28–30) suggest that serum LAP levels in AML patients are closely associated with the occurrence and progression of AML. Dynamic detection of this indicator helps evaluate the condition of AML patients. Still, this study did not examine in depth the relationship between changes in LAP levels and patient prognosis. GDGF is a key regulatory factor in the recruitment and activation of fibroblasts. Tumour cells can accelerate the transformation of common fibroblasts by secreting various activating factors, including GDGF, thereby promoting tumour growth and enhancing drug resistance. Therefore, measuring serum GDGF levels in AML patients helps evaluate disease progression. The serum LAP level in the study group was lower than in the control group, whereas the GDGF level was higher. Serum LAP and GDGF levels are independent predictors of AML patients' prognosis. Serum LAP and GDGF had AUCs of 0.747 and 0.811, respectively, for indicating prognosis in AML patients. The aforementioned findings suggest that aberrant serum LAP and GDGF levels are associated with AML and have some prognostic value.

The reasons for this are as follows: (1) LAP not only regulates cell growth, improves vascular permeability, and promotes vasoconstriction, but also alters the microenvironment within tumour tissues, thereby inhibiting the proliferation and metastasis of leukaemia cells and reducing disease recurrence. Therefore, a rise in its serum level may improve the prognosis of individuals with AML. (2) GDGF has certain carcinogenic potential. Tumour cells can promote tumour growth and the metastasis and proliferation of vascular endothelial cells and smooth muscle cells by secreting GDF, thereby facilitating the formation of tumour blood vessels and accelerating the spread and metastasis of tumour tissues. Moreover, GDGF can increase interstitial pressure, thereby hindering the absorption of anticancer drugs and reducing therapeutic efficacy in patients. Therefore, its level is strongly correlated with the prognosis of AML patients. The reason for this might be that LAP has a dose-dependent dual effect: at physiological concentrations, it exerts an antitumor effect by inhibiting proinflammatory responses and inducing tumour cell apoptosis. In the tumour microenvironment, when its level exceeds the threshold, it shifts to an immunosuppressive phenotype. By inhibiting NK cell and CD8+ T cell activity, the immunosuppressive microenvironment may ultimately promote tumour growth and metastasis.

Owing to abnormal white blood cell proliferation and the long-term use of antitumor drugs during treatment, the immunity of AML patients significantly decreases, making them highly prone to infections and exacerbating the inflammatory response, which is not conducive to their prognosis (31). In patients with AML, elevated neutrophil/lymphocyte ratio and albumin/fibrinogen ratio are both separate risk factors for a poor prognosis. In predicting a poor prognosis in patients with AML, the AUCs of the neutrophil/lymphocyte ratio and albumin/fibrinogen ratio were 0.783 and 0.845, respectively. The aforementioned findings indicate a relationship between the prognosis of AML patients and both the neutrophil-to-lymphocyte ratio and the albumin-to-fibrinogen ratio. The reasons for this are as follows: (1) An increase in the neutrophil count often indicates an increase in tumour-related inflammation, whereas a decrease in the lymphocyte count is associated with a weakened antitumor immune response. Both factors affect patients' prognosis. Therefore, an increase in the neutrophil/lymphocyte ratio reflects an increase in proinflammatory signals and a weakening of antitumor immunity; (2) it functions to maintain the stability of cell proliferation and enhance the immune response. Fibrinogen is not only related to the coagulation function of the body but also reflects the inflammatory state of the body. Moreover, it can accumulate at the tumour site and stimulate tumour cell growth.

The study's findings showed that the study group's serum ferritin levels were higher than those of the control group. Subsequent investigation revealed that a high serum ferritin level is a separate risk factor for AML patients' poor prognosis. Serum ferritin has an AUC of 0.804 for predicting a poor outcome in AML patients, suggesting that serum ferritin levels are associated with prognosis. Ferritin is reportedly an acute-phase protein produced by the body, and an abnormally elevated level is associated with inflammatory responses. Furthermore, ferritin levels in AML patients are closely correlated with both white blood cell and blast counts, indicating that ferritin levels are associated with tumour burden. Therefore, the abnormal increase in ferritin levels in

AML patients can reflect exacerbated inflammatory responses and increased tumour burden, thereby indicating a poor prognosis for patients.

Conclusion

Serum levels of LAP, GDDF ferritin, neutrophil/lymphocyte ratio, and albumin/fibrinogen ratio show some predictive value for prognosis and are associated with prognosis in AML patients. However, this study conducted statistical analysis only of the relevant detection indicators for patients at admission, without dynamic monitoring, which may have introduced some randomness into the research results. Further exploration of the dynamic changes in the levels of the above indicators is needed to make the research results more convincing.

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Conflict of interest statement

All the authors declare that they have no conflict of interest in this work.

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