SCINDEKS
Serbian Citation Index
J Med Biochem 2026; 45 DOI: 10.5937/jomb0-64239

UDK 577.1 : 61 **ISSN 1452-8258**

J Med Biochem 45: 1–9, 2026

Original paper
Originalni naučni rad

CORRELATION ANALYSIS OF LYMPHOCYTE SURFACE ANTIGEN AND THBS1 LEVELS WITH MYOCARDIAL INJURY IN SEPSIS PATIENTS

KORELACIONA ANALIZA POVRŠINSKOG ANTIGENA LIMFOCITA I NIVOA THBS1 SA OŠTEĆENJEM MIOKARDA KOD PACIJENATA SA SEPSOM

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Summary

Background: To analyse the relationships among the surface antigens of lymphocytes in patients with sepsis, the level of thrombospondin-1 (THBS1), and myocardial injury.
Methods: 360 sepsis patients who were hospitalised in our hospital between January 2023 and January 2025 were chosen. 170 patients with myocardial injury and 190 patients without myocardial injury were selected from the patient group based on whether or not they had myocardial injury. Serum THBS1 levels, immune function (CD4+, CD8+, and CD4+/CD8+), myocardial injury markers [creatine kinase MB (CK-MB), heart-type fatty acid binding protein (H-FABP), N-terminal pro-B-type natriuretic peptide (NT-proBNP), and cardiac troponin I (cTnI)], and echocardiographic markers (left ventricular ejection fraction (LVEF), early diastolic velocity to atrial contraction velocity ratio (E/A), and cardiac output (CO)] were compared. Correlations among immune function, THBS1 levels, myocardial injury markers, and echocardiographic markers were examined in individuals with myocardial damage and infection. To predict sepsis in patients with myocardial infarction, serum THBS1 levels

Kratak sadržaj

Uvod: Analiza povezanosti između površinskih antigena limfocita kod pacijenata sa sepsom, nivoa trombospondina-1 (THBS1) i oštećenja miokarda.
Metode: U studiju je uključeno 360 pacijenata sa sepsom koji su hospitalizovani u našoj ustanovi u periodu od januara 2023. do januara 2025. godine. Na osnovu prisustva oštećenja miokarda, pacijenti su podeljeni na grupu sa oštećenjem miokarda (n=170) i grupu bez ošteć enja miokarda (n=190). Upoređivani su nivoi serumskog THBS1, parametri imunološke funkcije (CD4+, CD8+ i odnos CD4+/CD8+), markeri oštećenja miokarda [kreatin-kinaza MB (CK-MB), srčani tip proteina koji vezuje masne kiseline (H-FABP), N-terminalni pro-B-tip natriuretskog peptida (NT-proBNP) i srčani troponin I (cTnI)], kao i ehokardiografski parametri [ejekciona frakcija leve komore (LVEF), odnos rane dijastolne brzine i brzine atrijalne kontrakcije (E/A) i minutni volumen srca (CO)]. Ispitivane su korelacije između parametara imunološke funkcije, nivoa THBS1, markera oštećenja miokarda i ehokardiografskih parametara kod pacijenata sa oštećenjem miokarda i infekcijom. Prediktivna vrednost serumskog THBS1 za dijagnostikovanje sepse kod

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were evaluated using receiver operating characteristic (ROC) curves and the area under the curve (AUC).
Results: While the myocardial injury group had significantly lower levels of CD8+ T cells in peripheral blood, LVEF, E/A, and CO, the nonmyocardial injury group had significantly higher levels of CD4+, CD4+/CD8+, serum THBS1, CK-MB, H-FABP, NT-proBNP, and cTnI ($P<0.05$). Patients with sepsis and myocardial injury had considerably higher peripheral blood CD8+ T cell counts with LVEF, E/A, and CO ($P<0.05$) and significantly lower counts with CK-MB, H-FABP, NT-proBNP, and cTnI ($P<0.05$). CK-MB, H-FABP, NT-proBNP, and cTnI were strongly positively correlated ($P<0.05$) with peripheral blood CD4+ and CD4+/CD8+ T cell counts, while LVEF, E/A, and CO were significantly correlated negatively ($P<0.05$). Serum THBS1 levels had a substantial negative correlation ($P<0.05$) with LVEF, E/A, and CO and a strong positive correlation ($P<0.05$) with CK-MB, H-FABP, NT-proBNP, and cTnI. With a sensitivity of 80.03% and specificity of 87.43%, the serum THBS1 concentration demonstrated an AUC of 0.892 (95% CI: 0.857–0.947) for predicting both sepsis and myocardial damage.
Conclusion: Sepsis patients' levels of THBS1 and lymphocyte surface antigens are somewhat linked to myocardial damage, and THBS1 is anticipated to function as a biomarker for predicting myocardial damage in sepsis patients.

Keywords: sepsis, T lymphocytes, immune function, platelet reaction protein-1, myocardial injury

pacijenata sa infarktom miokarda procenjena je pomoću ROC krive i površine ispod krive (AUC).
Rezultati: Grupa sa oštećenjem miokarda imala je značajno niže nivoe CD8+ T limfocita u perifernoj krvi, kao i niže vrednosti LVEF, E/A i CO, dok je grupa bez oštećenja miokarda imala značajno više vrednosti CD4+, odnosa CD4+/CD8+, serumskog THBS1, CK-MB, H-FABP, NT-proBNP i cTnI ($P < 0,05$). Kod pacijenata sa sepsom i oštećenjem miokarda, broj CD8+ T limfocita u perifernoj krvi bio je značajno pozitivno korelisan sa LVEF, E/A i CO ($P<0,05$), a značajno negativno sa CK-MB, H-FABP, NT-proBNP i cTnI ($P<0,05$). Vrednosti CK-MB, H-FABP, NT-proBNP i cTnI bile su snažno pozitivno korelisane ($P<0,05$) sa brojem CD4+ T limfocita i odnosom CD4+/CD8+, dok su LVEF, E/A i CO bile značajno negativno korelisane ($P<0,05$). Nivo serumskog THBS1 pokazao je značajnu negativnu korelaciju ($P<0,05$) sa LVEF, E/A i CO, kao i snažnu pozitivnu korelaciju ($P < 0,05$) sa CK-MB, H-FABP, NT-proBNP i cTnI. Uz senzitivnost od 80,03% i specifičnost od 87,43%, koncentracija serumskog THBS1 pokazala je AUC od 0,892 (95% CI: 0,857–0,947) u predviđanju istovremene pojave sepse i oštećenja miokarda.
Zaključak: Nivoi THBS1 i površinskih antigena limfocita kod pacijenata sa sepsom u određenoj meri su povezani sa oštećenjem miokarda, a očekuje se da THBS1 može imati ulogu biomarkera za predikciju oštećenja miokarda kod pacijenata sa sepsom.

Ključne reči: sepsa, T limfociti, imunološka funkcija, trombocitni reaktivni protein-1, oštećenje miokarda

Introduction

A systemic and all-encompassing inflammatory reaction, sepsis can cause serious consequences for individuals (1). The heart is one of the organs most susceptible to sepsis; research indicates that between 40 and 50 per cent of sepsis patients have myocardial damage, which can show up as heart failure, hypotension, and arrhythmias, and that about 20 per cent of patients may have myocardial damage (2). The myocardial dysfunction caused by sepsis is considered an important factor leading to patient death, and the mortality rate of sepsis patients with myocardial damage is as high as 70% to 90% (3). The mechanism of sepsis-induced myocardial injury is largely unknown. It needs more investigation, despite the widespread belief that myocardial apoptosis is a significant pathological hallmark of heart injury (4). Previous reports (5–7) indicate that immune disorders can lead to chronic inflammation, triggering myocardial remodelling and ultimately causing myocardial dysfunction. Thrombospondin-1 (THBS1), a se-creted glycoprotein, plays an important role in regulating the adhesion, migration, angiogenesis, and inflammatory response of vascular endothelial cells. Its level is closely related to myocardial damage (8).

To provide a scientific foundation for clinical diagnosis and therapy, this study examined the association between lymphocyte surface antigen levels and THBS1 levels in patients with sepsis and myocardial injury.

Materials and Methods

General information

The study subjects included 360 sepsis patients admitted to our hospital between January 2023 and January 2025.

Criteria for inclusion: ① Every patient who was included satisfied the sepsis diagnostic requirements. ② The first occurrence was the sickness. ③ The patients and their families provided their informed permission.

Criteria for exclusion: Individuals who have already undergone heart surgery. Other causes of myocardial damage include rheumatic heart valve disease, acute coronary syndrome, coronary atherosclerotic heart disease, immune system disorders, severe liver or renal failure, and malignant tumours.

Those patients who experienced myocardial injury (n=170) and those who did not (n=190) were divided into two groups to determine their status. The diagnostic criteria for myocardial damage

were as follows: cardiac ultrasound showed a left ventricular ejection fraction (LVEF) <50% and a left ventricular diastolic end-diastolic diameter ≥54 mm.

Immune function detection

All individuals included in the study had 10 mL of peripheral venous blood collected in the morning, after a fasting period. The samples were immediately processed for separation after collection. One of the samples was used for flow cytometry analysis on a BD FACSCanto II flow cytometer (BD Company, model number 644798). The surface antigens of CD4+ and CD8+ T lymphocytes were detected using the BD Company's Human CD4/CD8/CD45 triple-colour reagent (model number: 340502) and hemolysin (model number: 349202), following the instrument operation procedures strictly. After incubation with fluorescently labelled antibodies, hemolysis, and sample washing, the data were analysed using FlowJo software, and the absolute counts of CD4+ and CD8+ T lymphocytes and the CD4+/CD8+ ratio were calculated. All operations were completed within 2 hours after sample collection to ensure the accuracy and reliability of the test results.

THBS1 level detection

The collected venous blood samples were centrifuged at 3000 rpm for 10 minutes to separate the serum. Quantitative analysis was performed using the enzyme-linked immunosorbent assay (ELISA). The experiment used the ELISA kit for human thrombospondin-1 (THBS1) produced by Wuhan BoDe Biotechnology Co., Ltd. (item number: BD-TSP1-Hu) and was carried out strictly according to the instructions in the manual. During the detection process, a standard curve was established. The serum samples to be tested were diluted 1:100 and added to the pre-coated plate wells, and incubated at room temperature for 2 hours. Then, the biotin-labelled antibody working solution was added and incubated at 37 °C for 1 hour. Next, the horseradish peroxidase-labelled streptavidin was added, and the reaction was carried out in the dark for 30 minutes. Finally, the TMB substrate solution was added for colour development, and the reaction was terminated. The absorbance value was measured at 450 nm using an enzyme analyser. All samples were tested in duplicate, and the intra-batch coefficient of variation was <5%. The THBS1 concentration in the samples was calculated using the four-parameter logistic curve fitting. To ensure the accuracy of the results, positive and negative controls were included in each test batch, and a standard curve was established using the standard substances.

Detection of myocardial injury indicators

All samples were centrifuged at 3000 rpm for 10 minutes to separate the serum. The cardiac injury markers were detected using the enzyme-linked immunosorbent assay (ELISA). The detection indicators included: cardiac-type fatty acid-binding protein (H-FABP), cardiac troponin I (cTnI), creatine kinase isoenzyme (CK-MB), and N-terminal pro-brain natriuretic peptide precursor (NT-proBNP). The ELISA kits used in the experiment were all provided by Guangzhou Aorui Biotechnology Co., Ltd. The specific lot numbers were: H-FABP kit (AOR-HFABP-96T, batch number: 20230512), cTnI kit (AOR-cTnI-96T, batch number: 20230515), CK-MB kit (AOR-CKMB-96T, batch number: 20230510), and NT-proBNP kit (AOR-NTproBNP-96T, batch number: 20230518). The operation was carried out strictly according to the kit instructions, and the concentrations of each indicator were determined using the double-antibody sandwich method. The microplate reader measured the absorbance at 450 nm, and the concentrations of each marker in the samples were calculated from the standard curve.

Measurement of echocardiographic indicators

At enrollment, all patients' echocardiographic indicators, including LVEF, the ratio of diastolic velocity at the mitral valve orifice to atrial contraction velocity (early diastolic velocity to atrial contraction velocity, E/A), and cardiac output (cardiac output, CO), were measured using bedside ultrasound diagnostic equipment.

Statistical methods

Data analysis was done using IBM SPSS 26.0. For continuous data ($\bar{x}\pm s$), the independent t-test was used to compare groups; for categorical data, the χ^2 test was used, which are represented as [cases (%)]; the NYHA classification index of cardiac function was analysed using the rank sum test; the correlations between immune function, THBS1 levels, and cardiac injury indicators, as well as echocardiographic markers in patients with myocardial injury and sepsis, were examined using Pearson correlation; the utility of THBS1 for the prediction of sepsis and myocardial injury was examined using receiver operating characteristic (ROC) curves. It was deemed statistically significant if $P<0.05$.

Table I Comparison of clinical data between the two groups of patients [$\bar{x}\pm s$, Cases (%)].

Clinical data	Myocardial injury group (n=170)	Non myocardial injury group (n=190)	T/x^2/Z value	P value
Age (years)	65.72±9.18	66.34±8.86	0.381	0.691
Gender (Cases)			0.037	0.847
Male	96 (56.47)	110 (57.89)		
Female	74 (43.53)	80 (42.10)		
Body Mass Index (kg/m^2)	22.66±3.30	22.41±3.52	0.281	0.777
Infection site (Cases)			0.596	0.967
Lung	80 (47.06)	86 (45.26)		
Abdominal cavity	44 (25.88)	44 (23.16)		
Urinary system	24 (14.12)	32 (16.84)		
Skin and soft tissue	14 (8.23)	16 (8.42)		
Other	8 (4.70)	12 (6.31)		
NYHA classification of cardiac function (Cases)			27.987	<0.001
Level II	36 (21.18)	110 (57.89)		
Level III	78 (45.88)	60 (31.58)		
Level IV	56 (32.94)	20 (10.53)		

Table II Comparison of immune function and THBS1 levels between two groups of patients ($\bar{x}\pm s$).

Group	n	CD8+	CD4+	CD4+/CD8+	THBS1 (ng/mL)
Myocardial injury group	170	24.85±3.35	40.41±7.04	1.60±0.44	66.71±9.10
Non-myocardial injury group	190	28.33±4.28	37.11±5.39	1.38±0.33	50.98±8.58
T value		6.074	3.562	6.011	11.986
P value		<0.001	0.001	<0.001	<0.001

Results

Comparison of clinical data between the two groups

There were no statistically significant differences in age, sex, body mass index, or infection site between the two groups (P>0.05). However, there was a statistically significant difference in NYHA cardiac function classification between the two groups (P<0.05; see *Table I*).

There were significant differences in multiple indicators between the myocardial injury group and the non-myocardial injury group. The levels of CD8+ T cells in the peripheral blood of patients in the myocardial injury group were significantly lower. The ultrasound echocardiographic indicators, including left ventricular ejection fraction, early diastolic velocity ratio and atrial contraction velocity ratio, as well as cardiac output, were significantly lower in the myocardial injury group than in the non-myocardial injury group. On the contrary, the serum THBS1 level and the expression levels of various myocardial injury markers (creatine kinase isoenzyme, cardiac-type fatty acid binding protein, N-terminal pro-brain natriuretic peptide precursor and cardiac troponin I) in the serum of patients in the myocardial injury group were significantly higher than those in the non-myocardial injury group. These differences indicate that the occurrence of myocardial injury in patients with sepsis is closely related to immune dysfunction and the elevation of myocardial injury markers, providing an important basis for early clinical identification and intervention.

Comparison of immune function and THBS1 levels between the two groups of patients

The number of CD8+ cells in the peripheral blood of the myocardial injury group was significantly lower than that in the peripheral blood of the nonmyocardial injury group (P<0.05). The levels

Table III Comparison of serum CK-MB, H-FABP, NT proBNP, and cTnI levels between two groups of patients ($\bar{x}\pm s$).

Group	n	CK-MB (ng/mL)	H-FABP (ng/mL)	NT-proBNP (ng/L)	cTnI (ng/mL)
Myocardial injury group	170	15.65±4.96	29.52±6.03	2961.07±638.47	0.86±0.44
Non-myocardial injury group	190	10.27±2.99	11.98±2.06	1485.61±350.72	0.37±0.18
T value		8.985	26.982	19.483	10.860
P value		<0.001	<0.001	<0.001	<0.001

Table IV Comparison of echocardiographic indicators between two groups of patients ($\bar{x}\pm s$).

Group	n	LVEF	E/A	CO (L)
Myocardial injury group	170	39.59±4.67	0.82±0.24	1.75±0.58
Non-myocardial injury group	190	58.34±6.81	1.90±0.42	3.28±0.71
T value		21.183	18.821	15.046
P value		<0.001	<0.001	<0.001

of CD4+, CD4+/CD8+, and serum THBS1 were significantly higher in the myocardial injury group than in the nonmyocardial injury group (P<0.05; see *Table II*).

There are significant differences in immune function and THBS1 levels between the two groups of patients with and without myocardial injury in sepsis. The levels of CD8+ T lymphocytes in the peripheral blood of patients in the myocardial injury group were significantly lower, suggesting impaired cellular immune function; while patients in the non-myocardial injury group showed higher CD4+ T lymphocyte levels and a higher CD4+/CD8+ ratio, indicating a relatively better immune function status. Regarding THBS1 levels, there were also significant differences between the two patient groups. The expression level of THBS1 in patients with myocardial injury was significantly higher than that in the non-myocardial injury group, suggesting that THBS1 may play an important role in the occurrence and development of myocardial injury in sepsis.

Comparison of myocardial injury indicators between the two groups

Compared with those in the nonmyocardial injury group, the levels of serum CK-MB, H-FABP, NT-proBNP, and cTnI in the myocardial injury group were significantly higher (P<0.05; see *Table III*).

The expression levels of markers such as creatine kinase isoenzyme, cardiac-type fatty acid binding protein, N-terminal pro-B-type natriuretic peptide precursor, and cardiac troponin I in the serum of patients in the myocardial injury group were significantly higher than those in the non-myocardial injury group, indicating a more severe degree of myocardial cell damage. At the same time, cardiac ultrasound indicators in the myocardial injury group, including left ventricular ejection fraction, early diastolic velocity ratio, and heart output, were significantly lower than those in the non-myocardial injury group, suggesting more pronounced impairment of cardiac function.

Comparison of echocardiographic indicators between the two groups of patients

The LVEF, E/A, and CO in the myocardial injury group were significantly lower than those in the nonmyocardial injury group (P<0.05), see *Table IV*.

The left ventricular ejection fraction, early diastolic velocity ratio and cardiac output of patients in the myocardial injury group were significantly lower than those in the non-myocardial injury group, indicating that the cardiac contraction and relaxation functions of patients with sepsis and myocardial injury were significantly impaired. The reduction of these echocardiographic indicators reflects the overall decline in cardiac function in patients with myocardial injury. It is closely related to the degree of myocardial cell damage. At the same time, there is a significant correlation between echocardiographic indicators and immune function indicators, THBS1 levels, and myocardial injury markers, suggesting that immune-inflammatory responses and changes

Table V The relationship between immune function, THBS1 levels, and myocardial injury in patients with sepsis Correlation analysis between myocardial injury indicators and echocardiography indicators.

Indicator	Statistical value	CD8+	CD4+	CD4+/CD8+	THBS1
CK-MB	r value	-0.468	0.546	0.624	0.533
	P value	<0.001	<0.001	<0.001	<0.001
H-FABP	r value	-0.522	0.530	0.666	0.645
	P value	<0.001	<0.001	<0.001	<0.001
NT-proBNP	r value	-0.398	0.500	0.550	0.412
	P value	<0.001	<0.001	<0.001	<0.001
cTn I	r value	-0.527	0.515	0.639	0.579
	P value	<0.001	<0.001	<0.001	<0.001
LVEF	r value	0.398	-0.344	-0.465	-0.384
	P value	<0.001	<0.001	<0.001	<0.001
E/A	r value	0.437	-0.527	-0.542	-0.375
	P value	<0.001	<0.001	<0.001	<0.001
CO	r value	0.364	-0.072	-0.194	-0.378
	P value	0.001	0.476	0.084	<0.001

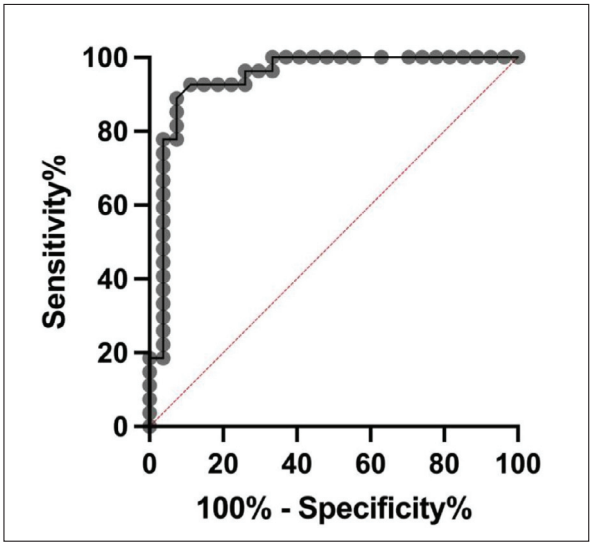

Figure 1 The interplay between Cys C and PON1: a hypothetical biochemical pathway.

in myocardial injury markers may jointly influence changes in cardiac function.

Correlation analysis of immune function, THBS1 levels, myocardial injury indicators and echocardiographic indicators in patients with sepsis and myocardial injury

The peripheral blood CD8+ level of patients with sepsis and myocardial injury was significantly negatively correlated with CK-MB, H-FABP, NT-proBNP, and cTnI ($P<0.05$) and significantly positively correlated with LVEF, E/A, and CO ($P<0.05$). The peripheral blood CD4+ and CD4+/CD8+ levels were significantly positively correlated with CK-MB, H-FABP, NT-proBNP, and cTnI ($P<0.05$) and significantly negatively correlated with LVEF and E/A ($P<0.05$). The serum THBS1 level was significantly positively correlated with CK-MB, H-FABP, NT-proBNP, and cTnI ($P<0.05$) and significantly negatively correlated with LVEF, E/A, and CO ($P<0.05$), see *Table V*.

The predictive value of serum THBS1 for sepsis combined with myocardial injury

When the optimal cutoff value of serum THBS1 was set at 58.85 ng/mL, the area under the curve (AUC) for predicting sepsis combined with myocardial injury was 0.892 (95% CI: 0.857–0.947), with a sensitivity of 80.03% and a specificity of 87.43% (*Figure 1)*.

Discussion

Sepsis is a severe pathogenic illness that can cause organ failure in patients and is brought on by the host's dysregulated response to infection (9). The heart is especially prone to harm during this procedure. Reduced cardiac output and cardiac insufficiency may be symptoms of early-stage sepsis associated with myocardial damage. In severe cases,

it can cause arrhythmia or heart failure, thereby significantly increasing the risk of death for the patient (10). However, there is currently no unified diagnostic standard for sepsis-induced myocardial injury. If laboratory markers that can predict sepsis-induced myocardial injury as early as possible can be identified, they will be extremely important for improving the prognosis of patients.

CD4+ cells are a type of induced T lymphocyte that can initiate the immune response mechanism of the body, thereby facilitating the clearance of pathogenic bacteria; CD8+ cells exert cell-mediated cytotoxicity on target cells, thereby promoting the inflammatory response; the ratio of CD4+/CD8+ cells can, to some extent, reflect the immune function status of the body (11). Once the immune function of an infected patient is imbalanced, it will be unable to resist the inflammatory response, ultimately inducing myocardial damage (12). As per the results of the study, the myocardial damage group's peripheral blood CD8+ level was significantly lower than that of the nonmyocardial injury group, although the CD4+ and CD4+/CD8+ levels were significantly higher than those of the nonmyocardial injury group. This implies that patients who have both cardiac damage and sepsis have a significant immunological imbalance. CK-MB, H-FABP, NT-proBNP, and cTnI are useful indicators of myocardial injury. CK-MB, H-FABP, NT-proBNP, and cTnI levels in the blood circulation sharply rise in response to myocardial cell injury (13–15). Echocardiography is a commonly used noninvasive examination method for evaluating cardiac function in clinical practice. Among them, LVEF can reflect left ventricular systolic function; E/A can be used to assess left ventricular diastolic function; and CO is an important indicator for measuring the efficiency of the circulatory system. The study showed that, while the serum levels of CK-MB, H-FABP, NT-proBNP, and cTnI were significantly higher than in the nonmyocardial injury group, the LVEF, E/A, and CO were significantly lower in the myocardial injury group. Further related research revealed a substantial negative correlation between the number of CD8+ T cells in peripheral blood and NT-proBNP, CK-MB, cTnI, and H-FABP in patients with sepsis and myocardial injury, and a significant positive correlation with LVEF, E/A, and CO. The levels of CD4+ and CD4+/CD8+ T cells showed a strong positive association with NT-proBNP, CK-MB, cTnI, and H-FABP, and a significant negative correlation with LVEF and E/A, suggesting that immunological dysfunction may contribute to myocardial injury induced by sepsis.

Although the precise mechanism of sepsis-induced myocardial damage remains unknown, evidence suggests that activation of the apoptotic pathway is a factor (16). THBS1 is a multifunctional protein expressed mainly by macrophages and platelets that binds and activates transforming growth factor-β1, thereby promoting inflammatory responses and playing an important role in extracellular matrix deposition and atrial fibrosis remodelling (17). In addition, THBS1 can interact with cardiac matrix metalloproteinases, type I collagen, and calcium ions, thereby regulating extracellular matrix metabolism in cardiac cells (18–20). The study demonstrated that the myocardial injury group had higher blood THBS1 levels than the nonmyocardial injury group, suggesting a potential association between THBS1 and sepsis-induced myocardial injury. The explanations are as follows: THBS1 can, on the one hand, encourage the overproduction of reactive oxygen species and free radicals, which can attack cell membranes, induce cell death, and lead to the production of caspase-3, thereby accelerating the process of myocardial injury; on the other hand, THBS1 may increase the expression of inflammatory factors such as tumor necrosis factor-α and interleukins, thereby aggravating the inflammatory response and ultimately inducing myocardial injury (21). In vitro studies (22–24) have confirmed that THBS1 expression is intimately linked to oxidative stress, apoptosis, and sepsis-induced cardiac damage, and it may be a therapeutic target for these conditions. In this study, the serum THBS1 level in patients with sepsis and myocardial injury was negatively correlated with echocardiographic indicators (LVEF, E/A, and CO) and positively correlated with myocardial injury indicators (NT-proBNP, CK-MB, cTnI, and H-FABP) using Pearson correlation analysis. This suggests that THBS1 is closely linked to myocardial injury caused by sepsis. The serum THBS1 level in patients with sepsis and myocardial injury was positively correlated with myocardial injury markers (NT-proBNP, CK-MB, cTnI, and H-FABP) and negatively correlated with echocardiographic markers (LVEF, E/A, and CO) using Pearson correlation analysis. These findings further demonstrated the close relationship between THBS1 and sepsis-induced myocardial injury. Additionally, the study's ROC curve showed that the serum THBS1 concentration had good predictive value for sepsis-induced myocardial injury, with an AUC of 0.892, a sensitivity of 80.03%, and a specificity of 87.43%.

Conclusion

The levels of lymphocyte surface antigens and THBS1 in patients with sepsis are associated with myocardial injury to some extent. Moreover, THBS1 is expected to serve as a biomarker for predicting myocardial injury in sepsis, thereby providing new ideas for the clinical formulation of effective treatment plans.

Authors' contributions

Min Wei and Wuchao Wang contributed equally to this work.

Funding

Gansu Province Science and Technology Project (24JRRA1090).

Conflict of interest statement

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

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Recieved: January 25, 2026
Accepted: March 03, 2026