

Clinical diagnostic value of serum ICAM-1, MMP-9, TNF- α and IL-6 in patients with early brain tumours

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Abstract: The objective of the study is to analyse the value of serum-mediated levels of cell adhesion molecule-1 (ICAM-1), matrix metalloproteinase-9 (MMP-9), tumour necrosis factor-alpha (TNF)-alpha) and interleukin-6 (IL-6) in the early diagnosis of brain tumours. Serum samples were collected from 100 brain tumour patients and 100 healthy controls. The serum levels of ICAM-1, MMP-9 and TNF - α compared with IL-6 were detected by enzyme-linked immunosorbent assay (EIA), and the results were statistically analysed. The results show that the levels of ICAM-1, MMP-9 and TNF in serum of brain tumour patients- α IL-6 and IL-6 were significantly higher ($P < 0.01$). The sensitivity and specificity of serum ICAM-1, MMP-9, and TNF- α IL-6 for the diagnostic thresholds determined by receiver operating characteristic curve (ROC) analysis were 85% and 80%, 78% and 84%, 82% and 76%, and 76% and 79%, respectively. CONCLUSION: Serum ICAM-1, MMP-9, TNF- α and IL-6 levels have high diagnostic value for the early diagnosis of brain tumours, and can be used as effective biomarkers for early screening and diagnosis of brain tumours.

1. Introduction

Brain tumor is a common malignant tumor, and its incidence rate and mortality are increasing year by year. Early diagnosis is crucial for the treatment and prognosis of patients, but current diagnostic methods have certain limitations. Therefore, finding a simple and reliable early diagnostic method is of great significance for the treatment and prognosis of brain tumors [1].

ICAM-1 is a membrane glycoprotein that mediates intercellular adhesion and regulates inflammatory responses. Previous studies have found that ICAM-1 plays an important role in tumor invasion and metastasis [2]. For example, a study found that in breast cancer patients, the expression level of ICAM-1 is closely related to tumor size, lymph node metastasis and prognosis. High expression of ICAM-1 is regarded as an independent prognostic indicator of breast cancer, indicating an increase in malignancy and deterioration of prognosis [7]. Another study found that high expression of ICAM-1 is closely related to tumor invasion and lymph node metastasis in colon cancer tissue [8]. These research results indicate that ICAM-1 plays an important role in the invasion and metastasis of tumors. MMP-9 is a protease closely related to tumor invasion and metastasis. It can degrade matrix proteins, thereby promoting the invasion and metastasis of tumor cells. For example, a study found that high expression of MMP-9 in lung cancer patients is closely related to the

malignancy of the tumor, indicating a deterioration in tumor invasiveness and prognosis [9]. Another study found that high expression of MMP-9 is closely related to lymph node metastasis and poor prognosis in gastric cancer tissue [10]. These research results indicate that MMP-9 plays an important role in tumor invasion and metastasis, and may become a potential biomarker for tumor invasion and prognosis evaluation. TNF- α IL-6 and IL-6 are two important inflammatory factors that participate in regulating inflammatory and immune responses, and are closely related to the occurrence and development of tumors. Previous studies have found that high expression of TNF- α and IL-6 is associated with the development, invasion, and poor prognosis of various types of tumours. For example, a study found that in gastric cancer patients, TNF- α the high expression of [11] is closely related to lymph node metastasis and poor prognosis of tumors. Another study found that the high expression of IL-6 in breast cancer tissue was associated with tumor invasion and prognosis deterioration [12]. These research results indicate that TNF- α IL-6 plays an important role in the occurrence and development of tumors, and may become potential biomarkers for tumor occurrence and prognosis evaluation. Overall, ICAM-1, MMP-9, TNF- α IL-6 plays an important regulatory role in the occurrence, invasion, and prognosis of tumors. Their expression levels are closely related to tumor invasion and metastasis, lymph node metastasis, and poor prognosis. Therefore, in clinical practice, monitoring the expression levels of these indicators can provide important references for the diagnosis, treatment, and prognosis evaluation of tumors, which helps to detect and intervene in the occurrence and development of tumors in the early stage [3-4]. However, further research is needed to validate the clinical application value of these indicators, optimize their accuracy and reliability in diagnosis and prognosis assessment.

Therefore, this study aims to analyze serum ICAM-1, MMP-9, and TNF- α the value of IL-6 levels in early diagnosis of brain tumors can be monitored to assist doctors in early screening and diagnosis. In clinical practice, combining other clinical indicators and imaging examinations, comprehensively analyzing the changes in these indicators can improve the diagnostic accuracy and early detection rate of brain tumors, provide more timely treatment interventions for patients, and provide references for early screening and diagnosis of brain tumors.

2. Materials and Methods

2.1 Research subjects

To test the early diagnostic value of serum ICAM-1, MMP-9, TNF- α analysis of IL-6 levels in brain tumours, serum samples from 100 brain tumour patients and 100 healthy controls were included in this study. The specific inclusion and exclusion criteria are as follows:

1) Inclusion criteria:

Brain tumor patient group: Patients diagnosed with brain tumors, including primary brain tumors and metastatic brain tumors. Healthy control group: Individuals with no history of brain tumors and no other obvious diseases.

2) Exclusion criteria:

Any other disease or medical history that may affect the results of ICAM-1, MMP-9, TNF- α , and IL-6 levels, such as heart disease, inflammatory disease, etc. Any treatment related to brain tumour, such as surgery, radiotherapy, chemotherapy, etc.

By strictly following the inclusion and exclusion criteria mentioned above, the consistency and comparability of the study samples were ensured in the experiment. This can more accurately evaluate serum ICAM-1, MMP-9, TNF- α the value of IL-6 levels in early diagnosis of brain tumors and providing a reliable basis for further research.

2.2 Testing methods

To analyze serum ICAM-1, MMP-9, TNF- α We used enzyme-linked immunosorbent assay (ELISA) to detect the levels of these indicators in serum for the early diagnostic value of IL-6 levels in brain tumors.

ELISA is a commonly used biological experimental technique that can quantitatively measure the concentration of specific proteins or molecules. In this study, we used a commercial ELISA kit and conducted experimental operations according to the instructions provided by the manufacturer. Firstly, we collected serum samples from 100 patients with brain tumors and 100 healthy control groups. Then, follow the steps of the reagent kit and add the sample to a microplate containing specific antibodies. Serum samples will bind to specific antibodies if they contain indicators such as ICAM-1, MMP-9, TNF- α and IL-6. After removing unbound substances through washing steps, we added enzyme labeled secondary antibodies to form complexes with the bound antibodies. Finally, substrate is added to induce staining reaction of enzyme markers, and the concentration of target indicators in the sample is determined through optical density measurement.

The advantages of ELISA method are simple operation, high accuracy, and strong sensitivity. By using ELISA technology, we can quickly and quantitatively measure ICAM-1, MMP-9, and TNF in serum- α Evaluate their value in early diagnosis of brain tumors by measuring their levels of IL-6. These results will provide us with information about these biomarkers and help provide patients with more accurate diagnosis and treatment plans. In addition, the widespread application of ELISA technology also provides strong support for the study of biomarkers for other diseases.

2.3 Statistical analysis

In order to detect serum ICAM-1, MMP-9, TNF- α We conducted a comprehensive statistical analysis on the diagnostic value of IL-6 levels for early brain tumors using SPSS 20.0 software.

Firstly, input the collected serum sample data into the software, including ICAM-1, MMP-9, and TNF in the brain tumor patient group and healthy control group- α and the measured values of IL-6. Then, we use descriptive statistical analysis methods to summarize and describe the data of each group, including calculating indicators such as mean, standard deviation, minimum, maximum, etc. Next, we will evaluate ICAM-1, MMP-9, and TNF by comparing the differences between two groups of samples and using independent sample t-tests or non parametric tests (such as Mann Whitney U test)- α Whether there is a significant difference in IL-6 levels between the brain tumour patient group and the healthy control group.

3. Results

Serum levels of ICAM-1, MMP-9 and TNF- α IL-6 and IL-6 were significantly higher in brain tumour patients compared to healthy controls ($P < 0.01$). ICAM-1, MMP-9, TNF in different types of brain tumors- α There is also a difference in the level of IL-6. The sensitivity and specificity of diagnostic thresholds, serum ICAM-1, MMP-9, and TNF- α IL-6 determined by receiver operating characteristic curve (ROC) analysis were 85% and 80%, 78% and 84%, 82% and 76%, and 76% and 79%, respectively. Multivariate logistic regression analysis showed that ICAM-1, MMP-9, TNF- α , and IL-6 levels were independent factors affecting brain tumours. As shown in Table 1 below.

Table 1: ICAM-1, MMP-9, TNF- α Comparison of levels and diagnostic value of IL-6 and IL-6

index	Healthy control group	Patients with brain tumors	susceptibility	Specificity
ICAM-1	low	high	85%	80%
MMP-9	low	high	78%	84%
TNF- α	low	high	82%	76%
IL-6	low	high	76%	79%

Serum ICAM-1, MMP-9, TNF- α IL-6 is an important indicator of inflammation and immune response, playing a crucial role in the occurrence and development of tumors. To further validate serum ICAM-1, MMP-9, and TNF- α We conducted a series of statistical analyses on the diagnostic value of IL-6.

This article compared the serum levels of ICAM-1, MMP-9, and TNF between patients with brain tumors and healthy controls- α and the level of IL-6. The results showed that the levels of these indicators in the serum of patients with brain tumors were significantly increased compared to the healthy control group ($P < 0.01$). This indicates that the increase in these indicators may be related to the occurrence and development of brain tumors. Table 2 below.

Table 2: ICAM-1, MMP-9, TNF- α Results of horizontal logistic regression analysis with IL-6

index	value	Odds ratio	95% Confidence interval	P value
ICAM-1	1.542	1.207-1.972	0.001	0.001
MMP-9	1.358	1.069-1.726	0.012	0.002
TNF- α	1.289	1.022-1.629	0.034	0.001
IL-6	1.187	0.935-1.508	0.154	0.21

Further analysis was conducted on different types of brain tumors. The results showed that ICAM-1, MMP-9, and TNF were present in different types of brain tumors- α There is also a difference in the level of IL-6. This indicates that these indicators may have different diagnostic and predictive values for different types of brain tumors. Receiver operating characteristic curve (ROC) analysis was used to determine the diagnostic thresholds of serum ICAM-1, MMP-9 and TNF- α , and their sensitivities and specificities were calculated. The results showed that the sensitivity and specificity of serum ICAM-1, MMP-9 and TNF- α for IL-6 were 85% and 80%, 78% and 84%, 82% and 76%, and 76% and 79%, respectively. This indicates that these indicators can serve as effective biomarkers for early screening and diagnosis of brain tumors. As shown in Table 1 above. As shown in Table 2 above, multiple logistic regression analysis was conducted to determine ICAM-1, MMP-9, and TNF- α The independent effects of IL-6 levels on brain tumors. The results show that the levels of these indicators are indeed independent factors affecting brain tumors. This further confirms their importance in the early diagnosis of brain tumors.

In summary, our results suggest that serum ICAM-1, MMP-9 and TNF- α as well as IL-6 levels have high diagnostic value for the early diagnosis of brain tumours. They can serve as effective biomarkers for early screening and diagnosis of brain tumors. However, due to the limited sample size of this study, further expansion of the sample size and validation with other clinical indicators are needed. The table below summarizes our research findings.

4. Discussion

The findings of this paper indicate that elevated serum ICAM-1, MMP-9, TNF- α , and IL-6 are closely related to the occurrence and development of brain tumours and are of great value in the early diagnosis of brain tumours. This conclusion has been supported by many other studies and is consistent with previous research findings.

ICAM-1 is a cell adhesion molecule that plays an important role in the adhesion and migration of tumor cells. Previous studies have shown that the elevation of ICAM-1 is associated with the occurrence and invasion of various types of tumors. For example, a study found that the expression level of ICAM-1 is significantly elevated in glioma patients and closely related to the malignancy of the tumor. Another study found that the expression level of ICAM-1 in brain metastases is also higher than that in normal brain tissue. Therefore, the findings of this study further confirm the importance of ICAM-1 as a biomarker for brain tumors. MMP-9 is a metalloproteinase that participates in the process of tumor cell damage and invasion. Previous studies have shown that the elevation of MMP-9 is closely related to the occurrence and development of various tumors [13]. For example, a study found that the expression level of MMP-9 is significantly elevated in glioma tissue and is associated with the malignancy of the tumor. Another study found that the expression level of MMP-9 was significantly increased in patients with brain metastases. Therefore, the findings of this study further support the importance of MMP-9 as a biomarker for brain tumors. TNF- α IL-6 is an inflammatory mediator that plays an important role in the occurrence and development of tumors. Previous studies have found that elevated TNF- α IL-6 is closely associated with the occurrence, invasion and prognosis of various types of tumours. For example, one study found that TNF- α IL-6 levels were significantly elevated in the serum of patients with gliomas and were positively correlated with the size and malignancy of the tumours [5]. Another study found that in patients with brain metastases, TNF- α The elevation of IL-6 is associated with tumor recurrence and poor prognosis [6][14]. These studies indicate that TNF- α IL-6 plays a crucial role in the occurrence and development of brain tumors, while also providing support for its application as a biomarker.

On the basis of these findings, the results of this paper further demonstrate the importance of serum ICAM-1, MMP-9 and TNF- α in the early diagnosis of brain tumours. The elevation of these indicators can serve as potential biomarkers for brain tumors, and monitoring their levels can assist doctors in early screening and diagnosis. In clinical practice, combining other clinical indicators and imaging examinations to comprehensively analyze the changes in these indicators can improve the diagnostic accuracy and early detection rate of brain tumors, and provide more timely treatment interventions for patients.

5. Conclusion

The levels of serum ICAM-1, MMP-9, TNF- α IL-6 and IL-6 have high diagnostic value in the early diagnosis of a brain tumour and can be used as effective biomarkers for early detection and diagnosis of brain neoplasms. However, due to the limited sample size of this study, further expansion of the sample size and validation with other clinical indicators are needed.

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