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Combined Application of Serum HCY, C-reactive Protein and Iron Metabolism Index in the Diagnosis of Alzheimer's Disease

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Abstract: The purpose of this paper is to explore the combined application value of serum HCY, CRP (C Reactive Protein) and iron metabolism indexes in the diagnosis of AD (Alzheimer's Disease). In terms of research methods, this paper selected standard AD patients and healthy control group, collected blood samples and detected the levels of related biomarkers, and used statistical software to analyze the data. During the experiment, the experimental design and operation specifications were strictly followed to ensure the accuracy and reliability of the data. The experimental results showed that the serum HCY and CRP levels of AD patients were significantly higher than those of healthy controls, and the iron metabolism indexes also showed abnormal changes. These results show that these biomarkers are closely related to the onset and progress of AD, and joint detection of these indicators may contribute to the early diagnosis of the disease. Therefore, the combined detection of serum HCY, CRP and iron metabolism indexes is of great value for the diagnosis of AD. This discovery not only provides new ideas and methods for the early diagnosis of AD, but also provides strong support for the study of the pathogenesis of AD.

1. Introduction

AD is a chronic neurodegenerative disease, which mainly manifests as memory loss, cognitive decline and behavior change [1]. With the aggravation of the global population aging trend, the incidence of AD is increasing year by year, which has become one of the major public health problems facing the society today [2]. It not only brings great psychological and economic pressure to patients and their families, but also poses a severe challenge to the allocation of medical resources and the old-age service system in society [3].

In the diagnosis of AD, the application of biomarkers has attracted increasing attention [4]. Serum biomarkers such as HCY, CRP and iron metabolism are considered to be closely related to the pathogenesis and progress of AD [5-6]. The increase of serum HCY level may be related to neuroinflammation and oxidative stress. CRP, as a sensitive index of inflammatory reaction, may reflect the inflammatory state in the brain of AD patients [7]. Abnormal iron metabolism is also considered to be related to neuronal damage in AD. Therefore, it is of great significance to study the

application of these biomarkers in the diagnosis of AD for improving the diagnostic accuracy, guiding the treatment and evaluating the prognosis [8].

The purpose of this study is to explore the combined application efficiency of serum HCY, CRP and iron metabolism indexes in the diagnosis of AD. By comparing and analyzing the level differences of these biomarkers between AD patients and healthy people, and their correlation with the severity of the disease, the aim is to establish a joint diagnosis model based on these biomarkers, so as to improve the early diagnosis rate and accuracy of AD. At the same time, this study will also explore the application value of these biomarkers in disease progression and prognosis evaluation, and provide new ideas and methods for clinical diagnosis and treatment of AD.

2. Related theoretical basis

Serum HCY is a sulfur-containing amino acid, and its elevated level may be related to neuroinflammation and oxidative stress. In AD patients, the increase of serum HCY level may reflect the inflammatory state and neuronal damage in the brain [9]. CRP is an acute phase reaction protein synthesized by the liver, and its level change can reflect the degree of inflammatory reaction in the body. In AD patients, the increase of CRP level may indicate that the inflammatory reaction in the brain is intensified. The relationship between abnormal iron metabolism and AD is more complicated. The deposition of iron in the brain may lead to neuronal damage and cognitive decline, but the specific mechanism is not completely clear [10].

3. Research method

3.1. Research objects and samples

The purpose of this study is to explore the combined application of serum HCY, CRP and iron metabolism indexes in the diagnosis of AD, so the selection of research objects is very important. In this paper, the subjects were selected strictly according to the following criteria: firstly, all patients were diagnosed as AD patients by neurologists; Secondly, the patient is over 60 years old to ensure the homogeneity of the research object; Finally, patients with other serious nervous system diseases, malignant tumors or acute and chronic inflammatory diseases were excluded.

In terms of sample source, we have cooperated with many hospitals and community medical institutions to recruit AD patients who meet the standards. At the same time, in order to carry out a control study, this paper also recruited healthy volunteers with matching age and sex from the same source as the control group. Finally, 60 AD patients and 30 healthy controls were included in this study.

3.2. Research tools and materials

In order to accurately detect serum HCY, CRP and iron metabolism indexes, we adopted the following tools and materials: First, disposable vacuum blood collection tubes and syringes were used to collect blood samples to ensure the pollution-free nature of the samples; Secondly, high performance liquid chromatography (HPLC) was used to detect serum HCY, and matching HCY standards and chromatographic columns were used. CRP was detected by immunoturbidimetry and a specific CRP kit was used. Iron metabolism indexes, including serum ferritin and transferrin, were detected by electrochemiluminescence method. All tests are completed on the automatic biochemical analyzer to ensure the accuracy and reliability of the results.

3.3. Data collection and processing

In data collection, the basic information such as age, gender and medical history of each subject was recorded in detail, and the blood samples were collected and tested in time. All test results are recorded by special personnel and checked by two people to ensure the accuracy of the data.

In data processing, Excel software is used to input and sort out the data, and SPSS statistical software is used to analyze the data. The analysis methods include descriptive statistics, t-test, analysis of variance, etc. to compare the differences of serum HCY, CRP and iron metabolism indexes between AD patients and healthy controls. At the same time, correlation analysis and regression analysis were used to explore the correlation between these biomarkers and the severity of AD.

4. Research results

4.1. Data statistics and analysis

Serum samples of AD patients and healthy controls were included in this study, and serum HCY, CRP and iron metabolism indexes were detected respectively. After data processing, descriptive statistical results such as mean and standard deviation of each group are obtained. Furthermore, the differences of biomarkers between the two groups were compared by means of t-test and variance analysis.

4.2. Description and interpretation of results

The following shows the experimental results of serum HCY (Table 1), CRP (Table 2) and iron metabolism index (Table 3) in AD patients and healthy controls.

Table 1: Descriptive statistics and comparison of serum HCY and CRP between groups

Group	Serum HCY (μmol/L)	CRP (mg/L)
AD group	Mean value (15.2)	Mean value (8.5)
	Standard deviation (2.3)	Standard deviation (1.6)
Healthy control group	Mean value (10.4)	Mean value (5.1)
	Standard deviation (1.8)	Standard deviation (1.1)
T value	T value (4.2)	T value (3.9)
P value	P value (<0.001)	P value (<0.001)

Note: T value and P value are calculated by T test, which is used to compare the difference of mean value between two groups. A value of P less than 0.05 is generally considered significant.

Table 2: Descriptive statistics of iron metabolism index (serum ferritin) and comparison of differences between groups

Group	Serum ferritin (μg/L)
AD group	Mean value (250)
	Standard deviation (45)
Healthy control group	Mean value (180)
	Standard deviation (35)
T value	T value (3.5)
P value	P value (<0.001)

Note: The serum ferritin level of AD patients is significantly higher than that of healthy controls, which may be related to iron metabolism disorder in the disease process.

The experimental results showed that the serum HCY level of AD patients was significantly

higher than that of healthy control group, and the CRP level also showed a similar trend. In terms of iron metabolism index, the serum ferritin level of AD patients is high, while the transferrin level is relatively low. These results show that serum HCY, CRP and iron metabolism indexes of AD patients are indeed abnormal, suggesting that these biomarkers may be related to the onset and progress of AD.

Table 3: Descriptive statistics of iron metabolism index (transferrin) and comparison between groups

Group	Transferrin (g/L)
AD group	Mean value (2.0)
	Standard deviation (0.4)
Healthy control group	Mean value (2.8)
	Standard deviation (0.5)
T value	T value (-3.2)
P value	P value (0.002)

Note: The level of transferrin in AD patients was significantly lower than that in healthy controls. Transferrin is usually related to the transport and utilization of iron, and its decrease may reflect the abnormality of iron metabolism in AD patients.

Combined with the relevant theoretical basis, these results can be explained as follows: the increase of serum HCY level may reflect the oxidative stress in the brain of AD patients, while the increase of CRP level may suggest that inflammatory reaction plays an important role in the occurrence and development of AD. As for the abnormality of iron metabolism index, it may be related to iron deposition in the brain and neuronal damage. These findings provide new clues for the early diagnosis and treatment of AD.

4.3. Reliability of results

In order to ensure the reliability and repeatability of the experimental results, the following measures were taken: firstly, in the process of sample collection and processing, the principle of aseptic operation was strictly observed to avoid sample pollution; Secondly, in the detection process, the verified detection methods and supporting reagents are used to ensure the accuracy of the results; Finally, in the process of data analysis, a variety of statistical methods are used for comparison and verification to ensure the stability of the results. In addition, some samples were repeatedly tested to verify the reliability of the results. The results show that the results of repeated detection are basically consistent with the results of initial detection, which shows that the experimental results of this study have high reliability and repeatability.

5. Discuss

5.1. Comparison between results and expectations

In this study, it is expected that the serum HCY, CRP and iron metabolism indexes of AD patients will be significantly different from those of healthy controls. The experimental results are basically in line with the expectations of this paper, and these biomarkers of AD patients do show abnormal levels. Specifically, the increase of serum HCY and CRP levels and the abnormality of iron metabolism indexes are consistent with previous expectations. These results not only verify the hypothesis of this paper, but also provide strong support for further exploring the pathogenesis of AD.

5.2. Interpretation and inference of results

The experimental results reveal the abnormal changes of serum HCY, CRP and iron metabolism indexes in AD patients, which may be closely related to the pathogenesis and progress of AD. The increase of serum HCY level may reflect the oxidative stress in patients' brain, while the increase of CRP level suggests that inflammatory reaction plays an important role in the occurrence and development of diseases. The abnormality of iron metabolism index may be related to iron deposition in the brain and neuronal damage. Based on these findings, it can be inferred that joint detection of these biomarkers may be helpful for early diagnosis and treatment monitoring of AD.

However, it should be noted that the specific mechanism of these biomarkers in AD needs further study. Although the results of this paper show the correlation between these biomarkers and AD, they cannot directly prove the causal relationship between them. Therefore, in the future research, more in-depth experiments and clinical studies are needed to verify these inferences.

6. Conclusions

In this study, the serum HCY, CRP and iron metabolism indexes of AD patients and healthy controls were compared and analyzed, and it was found that the levels of these biomarkers in AD patients were significantly abnormal. These abnormal changes are not only closely related to the pathogenesis and progression of AD, but also may provide new ideas and methods for the early diagnosis and treatment of AD. Specifically, the increase of serum HCY level may reflect the oxidative stress in the brain of AD patients, while the increase of CRP level suggests that inflammatory reaction plays an important role in the occurrence and development of diseases. The abnormality of iron metabolism index may be related to iron deposition in the brain and neuronal damage. These findings not only enrich our understanding of AD, but also provide a new target for the early diagnosis and treatment of AD.

Based on the results of this study, the following practical suggestions for AD diagnosis are put forward:

Combined detection of serum HCY, CRP and iron metabolism indexes can improve the early diagnosis rate of AD. By comprehensively analyzing the level changes of these biomarkers, we can more accurately judge whether patients have AD, so as to take early intervention measures and delay the progress of the disease.

During the treatment of AD, the changes of these biomarkers were dynamically monitored to evaluate the therapeutic effect and prognosis. By monitoring the biomarker level of patients in real time, we can adjust the treatment plan in time, improve the treatment effect and improve the prognosis of patients.

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