

The Diagnostic Value of Oligoclonal Band Detection in Viral Encephalitis

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Abstract

Objective: This study aims to explore the differences in cerebrospinal fluid oligoclonal band (CSF-OCB) expression among different age groups in viral encephalitis and its reference value for diagnosis. **Methods:** Forty-two patients with viral encephalitis were divided into two groups: 25 adults and 17 children. The presence of oligoclonal bands in the cerebrospinal fluid (CSF) was detected using polyacrylamide gel electrophoresis, and CSF routine analysis was conducted for comparative analysis. **Results:** The CSF-OCB positivity rate was higher in the adult group (48%) compared with the pediatric group (11.76%), with a statistically significant difference ($P < 0.05$). There was no significant difference in adult group between the CSF-OCB positivity rate (48%) and CSF white blood cell count positivity rate (44%), but was higher than the protein quantification analysis positivity rate (20%), with statistical significance ($P < 0.05$). In the pediatric group, there was no significant difference between the CSF-OCB positivity rate (11.76%) and protein quantification analysis positivity rate (17.65%), but it was lower than the CSF white blood cell count positivity rate (64.71%) ($P < 0.05$). **Conclusion:** 1) The expression of CSF-OCB positivity in patients with viral encephalitis is age-related, with higher positivity rates observed in adults compared to children. 2) Although CSF oligoclonal band detection is not a specific diagnostic marker for viral encephalitis in adults, it still holds certain reference value.

Keywords

Oligoclonal Band Detection, Viral Encephalitis, Routine Analysis of Cerebrospinal Fluid, Age

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1. Introduction

Central nervous system infection (CNSI) is a common neurological disorder and a significant infectious disease that poses a continuous threat to human health, characterized by relatively high mortality and morbidity rates [1]. Viral encephalitis is the most prevalent CNSI in both adults and children. However, clinical diagnosis of viral encephalitis in some patients is challenging due to the widespread use of antibiotics [2]. Numerous studies conducted globally and domestically [3] [4] have found that patients with viral encephalitis exhibit elevated levels of immunoglobulin (mainly IgG) in the cerebrospinal fluid (CSF) early in the disease course. Therefore, intrathecal synthesis of IgG serves as a valuable clinical indicator for the early diagnosis and differential diagnosis of viral encephalitis. Oligoclonal bands (OCBs) in the CSF, which qualitatively evaluate intrathecal IgG synthesis, have higher sensitivity than quantitative indicators and have become the gold standard for assessing intrathecal IgG synthesis [5] [6].

In recent years, there have been reports both domestically and internationally [7] [8] [9] [10] investigating the expression of CSF-OCBs in patients with viral encephalitis. However, there is lack of studies comparing the differences in CSF-OCB expression between adult and pediatric patients with viral encephalitis. If such differences exist, they may be related to the consistency of the central nervous system's immune response mechanisms in adults and children during CNS viral infections. Therefore, the main objective of this study is to investigate the expression and differences of CSF-OCBs in patients of different ages with viral encephalitis. Additionally, routine CSF analysis is a standard examination for patients with viral encephalitis. Therefore, we will evaluate the reference value of CSF-OCB detection for the diagnosis of viral encephalitis by comparing it with routine CSF analysis (white blood cell count and protein quantification analysis).

2. Materials and Methods

2.1. Patient Information

This study collected cerebrospinal fluid (CSF) samples from 42 patients diagnosed with viral encephalitis who were hospitalized in the Department of Neurology and Pediatrics at People's Hospital of Liaocheng City from January 2019 to January 2020 (meeting the diagnostic criteria for primary viral encephalitis [11]). Based on comprehensive clinical data, the patients were divided into the following two groups: Group 1: Adults, comprising 25 cases (10 males and 15 females) with an age range of 20 to 72 years and a mean age of 35 ± 15.26 years; Group 2: Children, comprising 17 cases (11 males and 6 females) with an age range of 1 to 13 years and a mean age of 5 ± 3.46 years. (Traditional diagnostic criteria for viral encephalitis: Based on the patient's medical history and typical clinical symptoms such as persistent fever, nausea and vomiting, positive meningeal irritation sign, disturbance of consciousness, muscle tone changes, obvious mental and behavioral abnormalities, etc., combined with relevant aux-

iliary examinations such as:

PCR testing of cerebrospinal fluid detects viral DNA or RNA; Duplicate serum and examination revealed a significant trend of changes in virus-specific antibodies; Inclusion bodies in the nucleus of tissue cells are found in brain tissue biopsy or pathology, or viral nucleic acid is found by in situ hybridization)

2.2. Study Methods

1) Sample Collection: A non-traumatic 2 mL CSF sample was collected from each patient during routine lumbar puncture examination and stored at -20 degrees Celsius.

2) Routine CSF Analysis: All CSF samples underwent white blood cell count and protein quantification analysis.

3) CSF-OCB Detection: CSF samples were subjected to detection using the DY CZ-24EN electrophoresis system produced by Beijing Liuyi Instrument Factory. Polyacrylamide gel electrophoresis (PAGE) was performed by preparing a 7.5% separating gel using acrylamide solution, separation gel buffer, distilled water, and ammonium persulfate. The CSF samples, along with bromophenol blue as an indicator, were loaded onto the gel. Electrophoresis was conducted until the bromophenol blue indicator reached a position 1 cm above the bottom of the gel. The gel was then removed and stained with Coomassie Brilliant Blue, followed by destaining.

4) OCB Interpretation: The presence of two or more bands within a range of 2 cm near the anode in the gamma globulin region was considered positive.

5) Interpretation of Routine CSF Results for Adults and Children (based on the second edition of Neurology published by People's Health Publishing House): For adults, abnormal results were defined as a CSF cell count greater than $5 \times 10^6/L$ and CSF protein quantification greater than 0.45 g/L. For children, abnormal results were defined as a CSF cell count greater than $10 \times 10^6/L$ and CSF protein quantification greater than 0.4 g/L.

2.3. Statistical Analysis

All data were analyzed using SPSS statistics 26.0 statistical software. Statistical methods included Chi-square test and its correction formula.

3. Results

Comparison of CSF-OCB Positivity Rates between the Adult and Child Groups: The CSF-OCB positivity rate in the adult group was 48%, while it was 11.8% in the child group. The difference in CSF-OCB positivity rates between the two groups was statistically significant ($P < 0.05$) (Table 1).

Comparison of CSF-OCB Detection and Routine CSF Analysis in the Adult Group: There was no statistically significant difference between the CSF-OCB positivity rate and the white blood cell count positivity rate in routine CSF analysis ($P > 0.05$). However, the CSF-OCB positivity rate was higher than the pro-

tein quantification analysis positivity rate ($P < 0.05$) (**Table 2 & Table 3**).

Comparison of CSF-OCB Detection and Routine CSF Analysis in the Child Group: There was no statistically significant difference between the CSF-OCB positivity rate and the protein quantification analysis positivity rate in routine CSF analysis ($P > 0.05$). However, the CSF-OCB positivity rate was lower than the white blood cell count positivity rate ($P < 0.05$) (**Table 4 & Table 5**).

CSF-OCB positivity Figure (**Figures 1-3**):

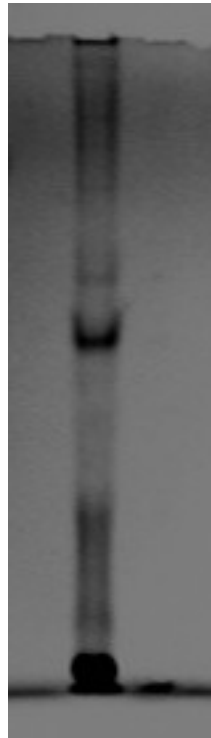


Figure 1. CSF-OB (+) band.

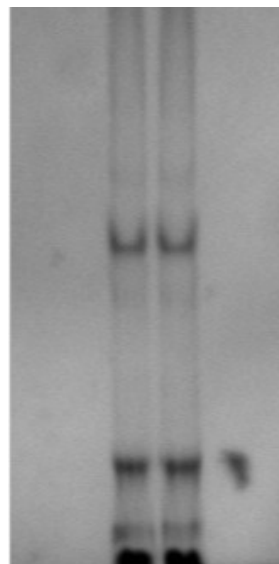


Figure 2. Adult group CSF-OB (+) band.

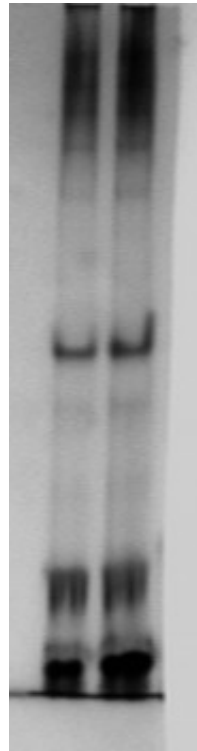


Figure 3. Children group CSF-OB (+) band.

Table 1. The number and proportion of patients with positive oligoclonal bands in CSF in the two groups.

	CSF-OCB Positive	CSF-OCB negative	total	CSF-OCB Positivity
adult	12	13	25	48%
child	2	15	17	11.8%

Note: $\chi^2 = 8.67$, $P < 0.005 < 0.05$.

Table 2. Comparison of adult CSF-OCB test results and white blood cell count test results.

CSF-OCB	CSF-WBC		Total
	positive	negative	
Positive	8	4	12
Negative	3	10	13

Note: $\chi^2 = 0$, $P > 0.05$.

Table 3. Comparison of adult CSF-OCB detection and protein quantitative detection results.

CSF-OCB	CSF-protein quantitative		Total
	positive	negative	
Positive	4	8	12
Negative	1	12	13

Note: $\chi^2 = 4$, $0.025 < P < 0.05$.

Table 4. Comparison of CSF oligoclonal bands and white blood cell count results in children.

CSF-OCB	CSF-WBC		Total
	positive	negative	
Positive	1	1	2
Negative	10	5	15

Note: $\chi^2 = 5.818$, $0.01 < P < 0.025$.

Table 5. Comparison of oligoclonal bands and protein quantitative detection results in children's CSF.

CSF-OCB	CFS-protein quantitative		Total
	positive	negative	
Positive	2	0	2
Negative	1	14	15

Note: $\chi^2 = 0$, $P > 0.05$.

4. Discussion

Previous studies on CSF oligoclonal bands (OCB) in patients with viral encephalitis have shown significant variations in the reported results. In studies of viral encephalitis in adults, domestic studies have reported OCB positivity rates of 47.6% for inflammatory neurological diseases of the central nervous system [12], while foreign scholars, Bourahoui *et al.*, reported OCB positivity rates of 30% to 50% for CNS inflammatory diseases [7]. Jinxing Wang *et al.* [9] reported an OCB positivity rate of 23.33% for CNS infectious diseases, which was lower compared to previous reports. In studies of viral encephalitis in children, Yuxiang Liu *et al.* [13] reported a high OCB positivity rate of 76.19% in children with viral encephalitis, while Chijian Xiao *et al.* [10] reported a lower OCB positivity rate of 21.7%. These findings deviate from previous conclusions. In the study, the OCB positivity rate in adult patients with viral encephalitis was 48%, which is consistent with previous reports in adult encephalitis studies. However, the OCB positivity rate in pediatric patients was only 11.8%, which is lower than previous reports. Regarding these differences, this article considers several possible factors that may influence the OCB detection results:

Firstly, related to the laboratory methods: American scholar Alexandre S. *et al.* [14] compared the differences between isoelectric focusing + immunoblotting and high-resolution agarose gel electrophoresis + immunofixation for OCB detection in 2003, and found that isoelectric focusing had higher sensitivity while agarose gel electrophoresis had higher specificity. Wenrong Zou *et al.* [15] conducted OCB detection using both isoelectric focusing and gel electrophoresis methods in 2008 and found that isoelectric focusing yielded a higher positivity rate compared to gel electrophoresis. Li Bin [16] mentioned that if the OCB de-

tection method employed isoelectric focusing + immunoblotting + dual antibody labeling + biotin-streptavidin amplification technology, the OCB positivity rate can be increased to 95%. Therefore, it can be concluded that the difference in detection methods is one of the reasons for the variation in OCB sensitivity. However, even when the same method is applied for testing, different results can still be obtained (this experiment used the same testing method as Yuxiang Liu), indicating that methodological differences are not the sole reason.

Secondly, related to treatment effects: Some studies have shown that corticosteroids can reduce intrathecal IgG synthesis, and there are differences in CSF-OCB among patients receiving different treatments [17]. Guo Li *et al.* [18] proposed that the immunosuppressive effects of steroids can inhibit the transformation of B cells into plasma cells, thereby reducing IgG secretion and affecting the detection rate of OCB. In this study, the patients did not undergo repeat lumbar puncture, and there was no comparison of CSF testing before and after steroid treatment. However, some patients in the sample had received steroid treatment to varying degrees, which may also be a factor influencing the result interpretation.

Thirdly, Related to the proficiency of the operator: apart from differences in equipment and methodology, the technical proficiency and quality control level of laboratory personnel can also affect the displayed results.

The present study found a higher rate of cerebrospinal fluid (CSF) oligoclonal band (OCB) positivity in adults with viral encephalitis compared to the pediatric group ($P < 0.05$). This suggests that adults with viral encephalitis have a higher propensity for local synthesis of immunoglobulins in the central nervous system, although the underlying mechanism remains unclear and warrants further investigation.

In the adult group, there was no statistically significant difference in OCB positivity between CSF OCB testing and CSF white cell count positivity. This indicates that OCB positivity does not correlate with the cellular count in the CSF. However, when comparing OCB testing with CSF protein quantification analysis, the OCB positivity rate was higher and statistically significant. This suggests that while OCB testing is not a specific marker for viral encephalitis, it still holds diagnostic value in guiding the diagnosis of this condition.

Interestingly, among the 25 adult patients in this study, 8 patients had completely normal CSF examination results, but 4 patients tested positive for OCB. This suggests a specific antigenic response within the central nervous system, highlighting the diagnostic reference value of OCB results for viral encephalitis, especially the patients with normal CSF examination results.

5. Conclusions

In conclusion, this study compared the expression of oligoclonal bands (OCB) in viral encephalitis patients of different age groups and evaluated the association between OCB testing results and cell count as well as protein quantification

analysis in the cerebrospinal fluid (CSF) of viral encephalitis patients. The following conclusions can be drawn:

The expression of CSF OCB in viral encephalitis patients is age-related, with a higher positivity rate observed in adults than in children.

Although CSF OCB testing is not a specific diagnostic marker for viral encephalitis in adults, It holds certain reference value for the patients with normal CSF examination results. Further research using more advanced testing methods and larger sample sizes is recommended to obtain more scientifically robust conclusions and provide guidance for the CSF auxiliary examination of viral encephalitis patients in the future.

Ethics Approval Statement

The research has been approved by the Ethics Committee of The Liaocheng People's Hospital.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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