DOI: 10.4274/MMJ.galenos.2025.43895
Medeni Med J 2025;40:128-135

Original Article

Clinical Impact of Cerebrospinal Fluid Multiplex Polymerase Chain Reaction (PCR) Testing in Children with Suspected Central Nervous System Infection

Merkezi Sinir Sistemi Enfeksiyonu Şüphesi Olan Çocuklarda Serebrospinal Sıvı Multipleks Polimeraz Zincir Reaksiyonu (PCR) Testinin Hasta Yönetimine Etkisi

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ABSTRACT

Objective: Central nervous system (CNS) infections remain a significant cause of morbidity and mortality in children. This study aimed to evaluate the impact of cerebrospinal fluid (CSF), multiplex polymerase chain reaction (PCR) panel results on clinical decision-making and patient management in children who underwent lumbar puncture (LP) with a preliminary diagnosis of meningitis/meningoencephalitis.

Methods: Patients aged 1 month to 18 years who underwent LP for suspected CNS infection in our pediatric emergency or intensive care units between 2018 and 2023, and who had a CSF multiplex PCR meningitis/encephalitis panel performed, were retrospectively evaluated in terms of demographics, clinical presentation, laboratory parameters, and treatments. Patients younger than 1 month or older than 18 years, those who underwent LP for non-infectious indications, and those with ventriculoperitoneal shunts were excluded. Data were analyzed using SPSS version 24.

Results: The median age of the 144 patients was 2.7 (6.7) years, and 93 (64.6%) were male. At least one pathogen was detected by multiplex PCR in 35 patients (24.3%). Of these, 22 had viral agents (enterovirus in 9, HSV-1 in 4, HHV-8 in 2, HHV-7 in 2, VZV in 2, CMV in 2, and HHV-6 in 1), 11 had bacterial agents [*Streptococcus pneumoniae (S. pneumoniae)* in 7, *Neisseria meningitidis* in 3, and *Haemophilus influenzae type b (Hib) in 1*], and 2 had multiple agents (*S. pneumoniae + Hib* + HHV-6 in one case; enterovirus + HHV-6 in one case). No significant clinical differences were observed between viral and bacterial infections. In 51 patients (35.4%), treatment was modified based on PCR results, most often by discontinuing acyclovir (22.1%), antibiotics (7.6%), or both (3.5%).

ÖZ

Amaç: Merkezi sinir sistemi enfeksiyonları çocuklarda hala önemli mortalite ve morbidite nedenleri arasındadır. Bu çalışmanın amacı, menenjit/meningoensefalit ön tanısı ile lomber ponksiyon (LP) yapılmış olan hastalarda bakılan beyin omurilik sıvısı (BOS) multipleks polimeraz zincir reaksiyonu (PCR) paneli sonuçlarının hasta yönetimi üzerine etkisinin değerlendirilmesidir.

Yöntemler: 2018-2023 yılları arasında çocuk acil ve çocuk yoğun bakım servislerimizde santral sinir sistemi enfeksiyonu şüphesiyle LP yapılmış ve BOS multipleks PCR yöntemiyle menenjit/ensefalit paneli gönderilmiş olan 1 ay-18 yaş arasındaki hastalar demografik, klinik, laboratuvar ve tedavi yöntemleri açısından retrospektif olarak değerlendirildi. Çalışmamıza <1 ay, >18 yaş, enfeksiyonla ilgili olmayan durumlar için LP yapılmış olan hastalar, Ventrikülperitoneal şantı olan hastalar dahil edilmedi. Verilerin istatistiksel analizleri için SPSS 24 programı kullanıldı.

Bulgular: Çalışmaya dahil edilen 144 hastanın medyan yaşı 2,7 (6,7) yıldı ve 93'ü (%64,6) erkekti. Toplam 144 hastanın 35'inde (%24,3) multipleks PCR yöntemiyle patojen saptandı. Bunların 22' sinde virüs (9 enterovirüs, 4 HSV-1, 2 HHV-8, 2 HHV-7, 2 VZV, 2 CMV, 1 HHV-6), 11'inde bakteri [7 pnömokok, 3 meningokok, 1 *Haemophilus influenzae* tip b (Hib)], 2' sinde çoklu pozitiflik (pnömokok + *Hib* + HHV-6, enterovirüs + HHV-6) vardı. Bakteri ve viral etken tespit edilen 35 olgu klinik bulgular açısından karşılaştırıldığında olgular arasında klinik açıdan anlamlı farklılık saptanmadı. Toplam 144 hastanın 51'sinde (%35,4) BOS-PCR sonucuna göre tedavi değişikliği yapıldı. En sık yapılan tedavi değişiklikleri sırasıyla asiklovir tedavisinin kesilmesi (%22,1), antibiyotik tedavisinin kesilmesi (%7,6), asiklovir ve antibiyotik tedavilerinin kesilmesi (%3,5) idi.

Sonuçlar: Çalışmamızda, BOS-PCR sonuçlarına göre hastaların yaklaşık üçte birinde gereksiz antiviral ya da antibiyotik tedaviler kesilmiş ve bu

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Cite as: Goktug A, Ak Gundogdu I, Duyu M, Besli E. Clinical impact of cerebrospinal fluid multiplex polymerase chain reaction (pcr) testing in children with suspected central nervous system infection. Medeni Med J. 2025;40:128-135

Received: 01 July 2025
Accepted: 01 August 2025
Published: 29 September 2025

Conclusions: In approximately one-third of cases, unnecessary antiviral or antibiotic treatments were discontinued based on PCR results, demonstrating the utility of molecular diagnostics in guiding clinical management. Especially in patients who had received antibiotics prior to LP, early pathogen detection via PCR may help reduce treatment costs, complications, and length of hospital stay.

Keywords: Central nervous system infections, cerebrospinal fluid, polymerase chain reaction (PCR)

moleküler testin hasta yönetimine yön verdiği gösterilmiştir. Özellikle LP öncesi antibiyotik tedavisi almış hastalarda, kültürde üretilemeyen bakterilerin PCR ile erken tespit edilebilmesi ve HSV dışındaki selim seyirli viral enfeksiyonlarda gereksiz antimikrobiyal tedavinin sonlandırılabilmesi için alınan BOS örneklerinden multipleks PCR paneli çalışılması gereksiz tedavi maliyetlerini ve komplikasyonları önleyip, hastane yatış sürelerinin azalmasına katkı sağlayabilir.

Anahtar kelimeler: Merkezi sinir sistemi enfeksiyonları, beyin omurilik sıvısı, polimeraz zincir reaksiyonu (PCR)

INTRODUCTION

Central nervous system (CNS) infections are defined as inflammation of the meninges or brain parenchyma due to infectious causes, and they remain among the leading causes of morbidity and mortality in children. With the inclusion of conjugated *Streptococcus pneumoniae* and *Haemophilus influenzae* type B (*Hib*) vaccines in routine immunization programs, viruses have become the most common cause of meningitis worldwide, including in Türkiye[1]. Most cases of viral meningitis except those caused by herpes simplex virus (HSV) generally follow a benign clinical course and are treated symptomatically. Although the incidence of bacterial meningitis has decreased, it remains a serious disease because of the risk of irreversible neurological damage or death if not promptly treated, making it a medical emergency.

It is often difficult to clinically distinguish between viral and bacterial CNS infections at presentation. Both types of meningitis can manifest with similar symptoms in children, such as fever, headache, photophobia, and neck stiffness. In neonates and infants, the typical signs of meningitis may be absent. Furthermore, commonly used diagnostic parameters like cerebrospinal fluid (CSF) pleocytosis and acute-phase reactants [e.g., C-reactive protein (CRP) and white blood cell count] are insufficient to reliably distinguish viral from bacterial meningitis[2]. The inability to determine the etiology early often leads to prolonged and potentially unnecessary use of antibiotics and antivirals, as well as extended hospital stays.

Molecular diagnostic tests based on polymerase chain reaction (PCR) -particularly multiplex PCR panels- allow rapid and reliable identification of multiple neurotropic pathogens in CSF samples. These tests enable timely and accurate pathogen identification and initiation of appropriate treatment. Moreover, if a benign viral agent such as enterovirus (EV) is identified, PCR can inform early clinical decision-making and potentially prevent unnecessary antimicrobial use [2-5].

The primary objective of this study was to evaluate the impact of CSF-PCR panel results on clinical decision-making and patient management in children who underwent lumbar puncture (LP) in pediatric emergency and intensive care units with a preliminary diagnosis of meningitis/meningoencephalitis. The secondary objective was to determine the frequency of viral and bacterial agents detected by the CSF-PCR panel and to assess whether clinical or laboratory features could predict the likely pathogen.

MATERIALS and METHODS

This retrospective study included patients aged one month to 18 years who underwent LP for suspected CNS infection in our pediatric emergency or intensive care units between 2018 and 2023, and had a CSF multiplex PCR Meningitis/Encephalitis panel (Bio-Speedy Meningitis/Encephalitis RT-PCR MX-17, Bioeksen, Istanbul, Türkiye) performed. We recorded each patient's demographic and clinical characteristics, laboratory findings, and treatment modalities.

Patients younger than one month or older than 18 years, those who underwent LP for non-infectious reasons (e.g., suspected intracranial hypertension, evaluation of seizures, metabolic workup, Guillain-Barré syndrome, autoimmune or vasculitic disease, malignancy, subarachnoid hemorrhage), and those with ventriculoperitoneal shunts were excluded.

Patients were classified into two groups based on the CSF-PCR results: viral or bacterial. Patients with mixed pathogens were assigned to the group that best matched their clinical presentation, as determined by the treating physician. The two groups were then compared in terms of clinical and laboratory characteristics. For acute-phase reactants, we defined the cut-off values as procalcitonin (PCT) >0.5 ng/ml and CRP >5 mg/L. For CSF analysis, pleocytosis was defined as >10 leukocytes/mm^3 for infants aged 1-3 months and >5 leukocytes/mm^3 for children older than 3 months. Elevated CSF protein was defined as >75 mg/dL for infants aged 1-3 months and >45 mg/dL for children older than 3 months. Low CSF glucose was defined as <40 mg/dL (or a CSF/serum glucose ratio <0.6) for infants aged 1-3 months, and <50 mg/dL (or a ratio <0.5) for children older than 3 months[6].

Children who have received at least two doses of conjugated Streptococcus pneumoniae vaccine and three doses of Haemophilus influenzae type B vaccine are considered 'fully vaccinated'.

Statistical Analysis

Statistical analyses were performed using SPSS version 24.0 (IBM, Chicago, IL, USA). Categorical variables were compared using the chi-square test. Continuous variables were compared using the Student's t-test or the Mann-Whitney U-test, depending on the distribution. A p-value <0.05 was considered statistically significant.

Ethics Committee Approval: This study was approved by the Istanbul Medeniyet University Goztepe Suleyman Yalcin City Hospital Clinical Research Ethics Committee (decision no: 2023/0604, date: 20.09.2023).

RESULTS

The median age of 144 patients was 2.7 years, with a standard deviation of 6.7 years, and 64.6% were male. Fourteen patients (9.8%) were incompletely vaccinated or had unknown vaccination status. At least one pathogen was detected by the multiplex PCR panel in 35 patients (24.3%). The demographic and clinical characteristics of patients with a detected pathogen are shown in Table 1. Of these, 22 had viral agents (EV in 9, HSV-1 in 4, Human herpes virus (HHV-8 in 2, HHV-7 in 2, Varicella zoster virus (VZV) in 2, Cytomegalovirus (CMV) in 2, and HHV-6 in 1), 11 had bacterial agents (*S. pneumoniae* in 7, *Neisseria meningitidis* in 3, and *Hib* in 1), and 2 had multiple agents (*S. pneumoniae* + *Hib* + HHV-6 in one case; EV + HHV-6 in one case) (Figure 1). Of the two patients with mixed infections, one was categorized in the viral group and the other in the bacterial group based on clinical presentation. The median turnaround time for CSF-PCR results was 24 hours (range 3-118 hours).

Among the patients with an identified pathogen (n=35), fever was present in 91.4%, vomiting in 57.1%, seizures in 34.3%, altered consciousness in 31.4%, signs of meningeal irritation in 28.6%, and headache in 25.7%. There were no statistically significant differences in presenting symptoms between the viral and bacterial cases (Table 1).

Table 1. Comparison of demographic and clinical characteristics and outcomes of bacterial and viral meningitis.

	Total (n=35)	Bacterium (n=12)	Virus (n=23)	p-value
Demographical features				
Gender, male†	20 (57,1)	6 (50)	14 (60,9)	0,537
Age, year§	5,5 (7,9)	2,1 (4,9)	1,3 (6,6)	0,614
Missing/unknown vaccination†	5 (14,3)	3 (25)	2 (8,6)	0,415
Immunosuppression†	0 (0)	0 (0)	0 (0)	
Antibiotic use before LP†	10 (28,6)	7 (58,3)	3 (13)	**0,015**
Clinical findings†				
Fever	32 (91,4)	12 (100)	20 (87)	0,536
Rash	3 (8,6)	1 (8,3)	2 (8,7)	1
Respiratory symptoms	5 (14,3)	1 (8,3)	4 (17,4)	0,64
Diarrhea	3 (8,6)	1 (8,3)	2 (8,7)	1
Headache	9 (25,7)	3 (25)	6 (26,1)	1
Vomiting	20 (57,1)	9 (75)	11 (47,8)	0,163
Change of consciousness	11 (31,4)	4 (33,3)	7 (30,4)	1
Convulsion	12 (34,3)	4 (33,3)	8 (34,8)	1
Meningeal irritation sign	10 (28,6)	4 (33,3)	6 (26,1)	0,706
Focal neurological deficit	2 (5,7)	0 (0)	2 (8,7)	0,536
Prognosis†				
Neurological sequela	4 (11,4)	2 (16,7)	2 (8,7)	0,594
Death	0 (0)	0 (0)	0 (0)	

†number (%), §median (interquartile range)

Laboratory comparisons revealed that patients in the bacterial group had significantly higher leukocyte counts, CRP, and PCT levels than those in the viral group (p=0.001, p<0.001, and p<0.001, respectively). In the CSF analysis, pleocytosis, elevated protein, and low glucose levels were significantly more frequent in the bacterial group compared to the viral group (p=0.027, 0.001, and 0.011, respectively) (Table 2).

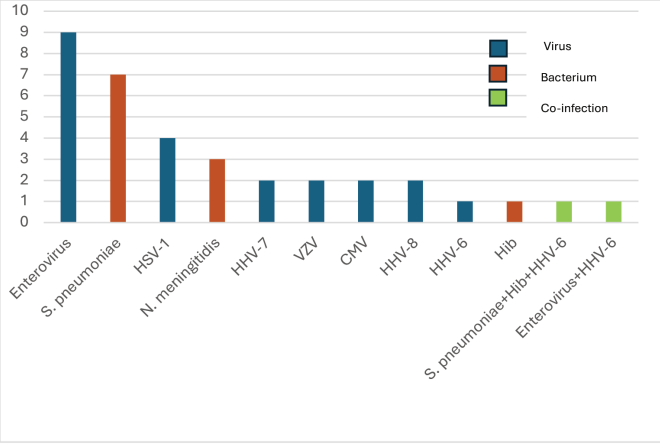

Figure 1. Distribution of microorganisms according to PCR results.

S.pneumoniae: Streptococcus pneumoniae, HSV-1:Herpes simplex virus type 1, *N. meningitidis: Neisseria meningitidis*, HHV-7: Human herpes virus 7, VZV: Varicella zoster virus, CMV: Cytomegalovirus, HHV-8: Human herpes virus 8, Hib: Haemophilus influenzae type B, HHV-6: Human herpes virus-6

Among 12 patients in the bacterial pathogen group, 9 (75%) were fully vaccinated and 7 (58.3%) had received antibiotics prior to LP. Only 2 (16.7%) of these 12 patients had positive CSF and/or blood culture results (Table 3). None of the PCR-negative patients had a positive culture.

In 51 of 144 patients (35.4%), the CSF-PCR results led to a change in clinical management. The most frequent modifications were discontinuation of acyclovir (22%), discontinuation of antibiotics (8%), and discontinuation of both (3%) (Figure 2). Among the 35 patients with a detected pathogen, 20 (57.1%) had their treatment altered based on the PCR findings. In terms of treatment duration, cases in the viral group had a significantly shorter antibiotic course, with a median of 5 days compared to 10 days in the bacterial group. Meanwhile, cases in the bacterial group had a significantly shorter antiviral (acyclovir) course, with a median of 2 days compared to 14 days in the viral group (p<0.001 for both) (Table 4).

DISCUSSION

In this study of 144 pediatric patients who underwent LP for suspected CNS infection, a multiplex PCR panel identified a viral or bacterial pathogen in approximately one-quarter of cases. Based on the CSF-PCR results, empiric treatments were modified in about one-third of all patients and in nearly half of those in whom a pathogen was detected. These modifications led to shorter antibiotic courses in viral meningitis cases and reduced

Table 2. Comparison of laboratory features of bacterial and viral meningitis.

	Total (n=35)	Bacteria (n=12)	Virus (n=23)	p-value
Acute phase reactants				
Leukocyte count[$], mm^3	11600 (9000)	18400 (14850)	10600 (5100)	**0,001**
Leukocytosis[†]	18 (51,4)	9 (75,0)	9 (39,1)	**0,044**
CRP, mg/L[$]	5 (22)	102 (116)	3 (16)	**<0,001**
Elevated CRP[†]	22 (62,9)	12 (100)	10 (43,5)	**0,001**
Procalcitonin, ng/ml[$]	0,2 (1,6)	30,7 (34,0)	0,2 (0,3)	**<0,001**
Elevated Procalcitonin[†]	11 (31,4)	8 (66,7)	3 (13)	**0,002**
CSF test findings[†]				
Pleocytosis	23 (65,7)	11 (91,7)	12 (52,2)	**0,027**
Elevated protein	16 (45,7)	10 (83,3)	6 (26,1)	**0,001**
Decreased glucose	8 (22,9)	6 (50)	2 (8,7)	**0,011**

[†]number (%), [$]median (interquartile range)
CSF: Cerebrospinal fluid, CRP: C-reaktive protein

Table 3. Characteristics of patients diagnosed with bacterial meningitis.

Patient number	Age, months	Gender	Vaccination status	Antibiotic use before LP	CSF culture growth	Blood culture growth	CSF Multiplex PCR
1	1	Boy	Fully vaccinated	No	Negative	Negative	*Streptococcus pneumoniae*
2	5	Girl	Fully vaccinated	Yes	Negative	Negative	*Streptococcus pneumoniae*
3	6	Girl	Unknown	Yes	Negative	Negative	*Streptococcus pneumoniae*
4	33	Boy	Fully vaccinated	No	Negative	Negative	*Streptococcus Pneumoniae*
5	60	Boy	Fully vaccinated	Yes	Negative	Negative	*Streptococcus pneumoniae*
6	84	Boy	Fully vaccinated	Yes	*Streptococcus pneumoniae*	Negative	*Streptococcus pneumoniae*
7	132	Boy	Fully vaccinated	Yes	Negative	Negative	*Streptococcus pneumoniae*
8	6	Girl	Unknown	No	*Streptococcus pneumoniae*	*Streptococcus pneumoniae*	*Streptococcus Pneumoniae* + *Haemophilus influenza* type B+ Human herpes virus-6
9	7	Girl	Fully vaccinated	No	Negative	Negative	*Neisseria meningitidis*
10	36	Boy	Fully vaccinated	Yes	Negative	Negative	*Neisseria meningitidis*
11	67	Girl	Fully vaccinated	Yes	Negative	Negative	*Neisseria meningitidis*
12	19	Girl	Incompletely vaccinated	No	Negative	Negative	*Haemophilus influenza* type B

LP: Lomber puncture; CSF: Cerebrospinal fluid, PCR: Polymerase chain reaction

Table 4. Impact of positive PCR results on patient management.

	Total (n=35)	Bacterium (n=12)	Virus (n=23)	p-value
Treatment change according to PCR†	20 (57,1)	7 (58,3)	13 (56,5)	0,918
Duration of antibiotic treatment, day§	10 (7)	10 (44)	5 (7)	**<0,001****
Duration of acyclovir treatment, day§	5 (12)	2 (2)	14 (7)	**<0,001****
Duration of hospitalization, day§	14 (16)	10 (50)	14 (15)	0,31

†number (%), § median (interquartile range)
*p<0,05, **p<0,01, PCR: Polymerase chain reaction

antiviral (acyclovir) use in bacterial meningitis cases. Our findings thus demonstrate the clinical utility of multiplex CSF-PCR panels in guiding patient management.

Identifying the causative agent in CNS infections is critical for determining appropriate treatment and predicting prognosis. However, clinical features often overlap between viral and bacterial infections, and the sensitivity and specificity of individual acute-phase reactants (e.g., CRP, PCT) are low in identifying specific pathogens. Therefore, it is recommended to interpret these markers alongside clinical scoring systems[7,8]. In our study, we found no significant differences in clinical

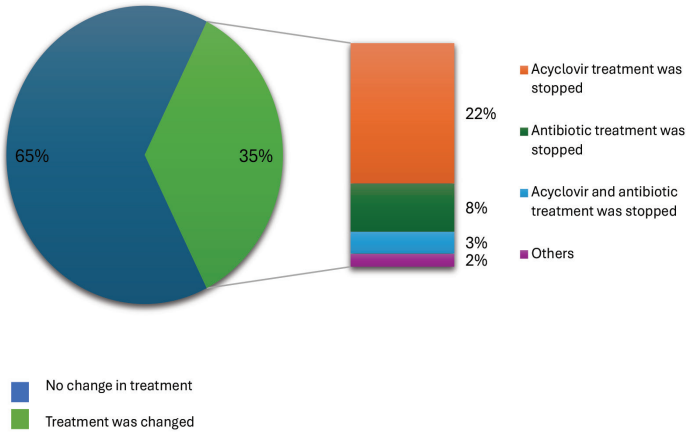

Figure 2. Treatment changes based on PCR results.

presentation between viral and bacterial cases, but laboratory markers such as CRP, PCT, and leukocyte count were significantly higher in the bacterial group ($p<0.001$ for all). Similarly, CSF analysis showed that pleocytosis, elevated protein, and decreased glucose were significantly more common in bacterial meningoencephalitis than in viral cases ($p=0.027$, 0.001, 0.011). While these findings suggest that laboratory parameters may aid in the differential diagnosis, the gold standard remains the identification of the specific pathogen via molecular methods or culture.

Recently developed multiplex PCR panels provide rapid, highly sensitive, and specific identification of causative microorganisms. For example, a multicenter evaluation of the FilmArray ME panel reported 100% sensitivity for most bacterial pathogens and over 99% specificity[9]. Published positivity rates for CSF multiplex PCR range from 18.8% to 32.8%[10-12], aligning with our positivity rate of 24.3%. Differences in detection rates may be due to variability in clinical indications for LP and differences in the PCR panels used.

Viruses are currently the leading cause of meningitis worldwide. In pediatric studies using PCR for the etiologic diagnosis of meningoencephalitis, viral pathogens were detected in 79.7% of cases in the study by Ayhan et al.[12], 84.5% in the study by Mizuno et al.[13], and 53.7% in the study by Bal et al.[14] In our study, viral pathogens accounted for 65.7% of PCR-positive cases, which is consistent with these reports. Globally, EVs are responsible for nearly 85% of viral meningoencephalitis cases[15]. EVs generally cause a mild clinical course and result in aseptic meningitis[3,4,16]. Although HSV-1 is encountered less frequently, it is the most common cause of sporadic necrotizing encephalitis[17].

Findings from different regions show some variations in the prevalent viral agents. In a multicenter pediatric study from Japan, parechovirus (45%) and EV (43%) were the most common causes of viral CNS infections, whereas a study from Türkiye found EV (23.5%), adenovirus (22%), and HHV-6 (22%) to be the most common,[13,18]; HSV-1 positivity in the latter study was 5.9%. In our study, EV was detected in 43.5% of viral cases, followed by HSV-1 in 17.4%, a finding which aligns with the literature. Differences between studies may result from variations in seasonality, socioeconomic status, indications for LP, patient age, and geographic location.

Although the prevalence of bacterial meningitis has declined in countries with routine *S. pneumoniae* and *Hib* vaccination programs, it remains a major concern due to its high morbidity and mortality[19]. While CSF culture is the gold standard for diagnosing bacterial meningitis, prior antibiotic use often decreases culture yield. Thus, multiplex PCR testing has become increasingly important. Studies from various countries report bacterial pathogen detection rates via multiplex PCR ranging from 15.5% to 23% [13,20]. In Türkiye, Ayhan et al.[12] reported a bacterial detection rate of 20.6%, and Bal et al.[14] reported a rate of 36.3%. Our study found a rate of 34.3%. The higher rates in studies from Türkiye compared to other regions might be attributable to differences in vaccination coverage, population characteristics, or study periods.

In patients with suspected meningitis, antibiotic treatment is often initiated before LP is performed, complicating culture-based diagnosis. Additionally, performing LP in children can be technically challenging, and the CSF volume obtained may be insufficient for culture. In a multicenter Turkish study by Ceyhan et al.[19], among 645 patients with bacterial pathogens detected by PCR, 74% had received antibiotics before LP, and the culture positivity rate was only 16.2%. Similarly, in our study, of 12 patients with bacterial pathogens detected by PCR, 7 (58.3%) had received antibiotics before LP, and only one had a positive culture. Overall, bacterial growth in CSF and/or blood cultures was identified in just 2 cases (16.7%). These findings highlight that multiplex PCR panels can detect bacterial meningitis pathogens even in patients who have already received antibiotics, allowing for earlier targeted treatment and potentially reducing morbidity and mortality. However, PCR results should always be interpreted in the context of the clinical presentation, as some pathogens may not be included in the panel and false-positive or false-negative results, though rare, can occur.

As a general principle, children with suspected CNS infection should be treated empirically for bacterial meningitis or HSV encephalitis until those diagnoses are excluded. This approach can lead to unnecessary prolonged use of antibiotics or acyclovir, longer hospital stays, and increased healthcare costs, especially in cases that ultimately prove to be benign viral infections[4]. Previous studies have shown that rapid PCR testing of CSF can reduce unnecessary antimicrobial use and shorten hospital stays[1,4]. For example, in pediatric patients with a positive CSF EV PCR result, the duration of IV antibiotic therapy was shortened by a median of 1.5 days, hospital stay decreased from 71.5 to 42 hours, and discharge occurred about 5 hours after the result became available. In contrast, PCR-negative or untested patients often received longer empirical treatment[4]. In our study, therapeutic modifications were made in 51 patients (35.4%) based on the PCR results. The most common change was discontinuation of acyclovir (22.1% of patients), followed by antibiotics (7.6%) and both (3.5%). These changes significantly shortened the duration of antibiotic therapy in viral cases and the duration of antiviral (acyclovir) therapy in bacterial cases ($p<0.001$ for both). The widespread use of multiplex PCR panels in emergency settings may help identify benign viral cases early and allow prompt discontinuation of unnecessary treatments, thereby reducing hospital stays and healthcare costs.

The impact of PCR results on clinical decision-making also depends on the test turnaround time. When results are available within 24 hours, studies report that antibiotic use can be reduced by approximately 20%, yielding significant cost savings[3]. In our study, the median PCR turnaround time was 24 hours (range 3-118 hours), which is relatively long. While this turnaround did not facilitate early discharge from the emergency department, it did allow for shorter durations of unnecessary antimicrobial use. In the future, the use of faster molecular diagnostic methods may enable earlier discontinuation of empirical treatments and safe discharge from the emergency department[3,4].

Study Limitations

This study has some limitations. It was a single-center retrospective study with a relatively small sample size, and we did not perform confirmatory testing (e.g., sequencing or separate PCR assays) for the pathogens detected by the panel. Prospective studies with larger cohorts and broader testing panels are needed to further evaluate the clinical and cost-effectiveness of multiplex PCR testing in CNS infections.

CONCLUSION

CSF multiplex PCR testing is a valuable diagnostic tool for children with suspected CNS infections, as it can rapidly identify causative pathogens and guide early therapeutic decisions. Our findings indicate that PCR results enabled the discontinuation of unnecessary antimicrobial treatments in many cases, thereby shortening treatment durations and potentially reducing hospital stays and healthcare costs. Wider implementation of rapid multiplex PCR panels in clinical practice, along with further large-scale studies, may help improve the management and outcomes of pediatric CNS infections.

Ethics

Ethics Committee Approval: This study was approved by the Istanbul Medeniyet University Goztepe Suleyman Yalcin City Hospital Clinical Research Ethics Committee (decision no: 2023/0604, date: 20.09.2023).

Informed Consent: This is a retrospective study.

Footnotes

Author Contributions

Surgical and Medical Practices: A.G., Concept: M.D., E.B., Design: İ.A.G., E.B. Data Collection and/or Processing: A.G., Analysis or Interpretation: M.D., E.B., Literature Search: A.G., İ.A.G., Writing: A.G., İ.A.G.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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