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Epidemiological profile of viral meningitis agents based on molecular diagnosis, Muğla, Türkiye (2019--2024)

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MAIN POINTS

- This is the first study investigating viral meningitis agents and their current distribution in Muğla Province.
- Rapid and accurate identification of viral pathogens is essential for appropriate management, reducing unnecessary antibiotic use and shortening hospital stays.
- Viral detection rates were lower than those reported nationally and internationally, possibly because some samples were collected mainly to exclude acute viral meningitis.
- Although enteroviruses are the leading cause of viral meningitis worldwide, HSV-1 and VZV were the most frequently detected pathogens in our study.

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ABSTRACT

Aim: Meningitis is an inflammation of the meninges, and viruses are among the most common causative agents. Due to the lack of regional data, this study aimed to evaluate the etiology and frequency of viral meningitis in Muğla, with a particular focus on the most common pathogens in pediatric and adult patients.

Materials and Methods: The study included 867 individuals whose CSF samples were tested by PCR between August 2019 and September 2024. Pathogens causing viral meningitis, including Enterovirus, Parechovirus, HSV-1, HSV-2, VZV, and Mumps, were assessed using the Fast Track Diagnostic multiplex real-time PCR viral panel kit.

Results: The mean age of the 867 participants was 46.96 ± 24.93 years, with 45.8% being female, 14.6% pediatric cases, and 1.0% of foreign nationality. Viral pathogens were detected in 35 cases (4.0%). Among these, 5.5% were male, a proportion that was statistically higher than that of females (p=0.015). Additionally, 6.3% were children, and 11.1% were foreign nationals. The most frequently identified pathogens were HSV-1 (2.1%) and VZV (1.0%). The least detected pathogens were Mumps and Parechovirus, with one case each. In pediatric cases, the most common pathogen was VZV (2.4%), whereas in adults, it was HSV-1 (2.2%). Among foreign nationals, only HSV-1 was identified (1 case). Viral pathogens were detected at the highest rate in 2023 (5.2%). The highest prevalence across age groups was observed in individuals aged 35--64 years (37.1%).

Conclusion: This study represents the first report of the molecular diagnosis of viral meningitis in Muğla. Our findings reflect the incidence of viral meningitis in the region. The use of molecular methods to identify viral pathogens plays a critical role in patient management. Detecting the causative agent in viral meningitis reduces inappropriate antibiotic use, length of hospital stay, and associated costs.

Keywords: Viral meningitis, HSV-1, HSV-2, VZV, Mumps, Enterovirus, Parechovirus
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INTRODUCTION

Central nervous system (CNS) viral infections, including meningitis, encephalitis, and myelitis, are commonly encountered in clinical practice worldwide. Among these, viral meningitis constitutes the majority of total viral CNS infections, making it one of the most prevalent CNS infections [1]. Meningitis is defined as inflammation of the meninges associated with an abnormal number of cells in the CSF. Aseptic meningitis, characterized by the absence of bacterial growth in cultures, is the most frequent form and is commonly caused by viruses. Because vaccination has reduced the prevalence of bacterial meningitis, viral causes of meningitis have become more prominent, and viral meningitis is now the most common form in many countries.

Viral meningitis typically presents with acute onset of fever, headache, photophobia, neck stiffness, and often nausea and vomiting; however, young children may not exhibit signs of meningeal irritation [2]. While viral meningitis is generally self-limiting in most children and requires only supportive treatment, advances in diagnostic capabilities, including the widespread use of polymerase chain reaction (PCR), have reduced hospital stays and antibiotic use. Nevertheless, aseptic meningitis continues to pose a significant healthcare burden [3].

Among viral meningitis agents, enteroviruses account for up to 80% of cases with an identified etiologic agent. Another pathogen of significance is parechovirus, particularly type 3, which represents a major cause of CNS infections in neonates. Both are RNA viruses belonging to the *Picornaviridae* family [4]. Herpes Simplex Virus 1 (HSV-1) and Herpes Simplex Virus 2 (HSV-2) can also cause viral meningitis. HSV-1 is more commonly associated with sporadic encephalitis, while HSV-2 can cause benign recurrent viral meningitis, often occurring in the absence of genital lesions or a history of genital herpes infection [4]. HSV reaches the CNS through cranial nerves. Varicella-Zoster Virus (VZV) is more likely to cause viral meningitis during reactivation than during primary infection, and varicella meningitis can occur without cutaneous lesions [2].

Before the introduction of the measles, mumps, and rubella (MMR) vaccine, mumps was a leading cause of viral meningitis and was more frequently observed in male patients [5]. Other viral causes include adenovirus, lymphocytic choriomeningitis virus (LCMV), influenza, parainfluenza, and Mumps [2]. Arboviruses capable of causing viral meningitis include West Nile virus (WNV), Zika virus, chikungunya virus, dengue virus, LaCrosse virus, Saint Louis encephalitis virus, Powassan virus, and Eastern equine encephalitis virus. Viral meningitis is most commonly observed in young children, and its incidence decreases with age. In temperate climates, viral meningitis occurs predominantly in the summer and autumn months, whereas in tropical and subtropical regions, it is seen year-round [6].

The current standard of care for viral infections includes antiviral therapy. However, these drugs are often ineffective in depleting viral reservoirs, either due to their lack of specificity or failure to cross specialized CNS barrier structures [7]. Therefore, the rapid and accurate identification of causative agents, along with targeted therapy, is critically important for managing these viral diseases. This study aims to evaluate the etiology and frequency of viral meningitis and to identify its most common causative agents in pediatric and adult patients in Muğla, Turkey. Muğla is a major tourist destination that experiences significant seasonal population mobility. In addition, its Mediterranean climate and coastal geography may influence viral transmission patterns. These regional characteristics may have implications for the epidemiology of viral central nervous system infections.

MATERIALS AND METHODS

A total of 867 cerebrospinal fluid (CSF) samples, sent between August 2019 and September 2024 to the Medical Microbiology Laboratory of Muğla Training and Research Hospital for nucleic acid testing to diagnose viral central nervous system infections, were retrospectively evaluated. This study was approved by the Ethics Committee of Muğla Sıtkı Koçman University Faculty of Medicine and the Muğla Training and Research Hospital (Decision no: 163, Date: 09.12.2024). Cerebrospinal fluid (CSF) samples that were analyzed by multiplex real-time PCR in the molecular microbiology laboratory and were obtained from patients with a preliminary diagnosis of viral meningitis were included in the study. Samples that did not meet this criterion, as well as those not analyzed by multiplex real-time PCR between August 2019 and September 2024, were excluded from the study.

Nucleic acids of viral pathogens, including HSV-1, HSV-2, Mumps virus, VZV, Enteroviruses (EV), and Parechovirus (HPeV), were routinely screened weekly in all cerebrospinal fluid (CSF) samples using the Fast-Track Diagnostics (FTD) multiplex real-time PCR panel (Fast Track Diagnostics Ltd., Luxembourg), which is CE-IVD approved for in vitro diagnostic use in Europe. Microbial nucleic acids were extracted from CSF samples using the EZ1 automated system with the EZ1 and 2 Virus Mini Kit v2.0 (Qiagen, Germany). The amplification step of the assay was performed on the Rotor-Gene Q analyzer (Qiagen, Germany). The cases of viral meningitis were assessed by age groups: ≤1, 1-5, 6-17, 18-34, 35-64, and ≥65 years.

Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics version 22 (SPSS Inc., Chicago, IL, USA). The normality of the distribution of continuous variables was assessed using visual (histograms) and analytical (Kolmogorov-Smirnov and Shapiro-Wilk tests) methods. To compare continuous variables between groups, either the Student's t-test or the Mann-Whitney U test was used, depending on the distribution of the data. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Results with a p-value less than 0.05 were considered statistically significant. Power analysis was performed using the G*Power 3.1.9.4, which indicated that a sample size of at least 128 was required. Our study used a non-probability sampling method; all consecutive cerebrospinal fluid samples collected between August 2019 and September 2024 that met the inclusion criteria were included. The 95% confidence intervals (95% CI) for the incidence rates were calculated using the binomial distribution.

RESULTS

A total of 867 CSF samples from individuals who underwent testing for viral meningitis agents by multiplex real-time PCR were included in this study. The mean age of the 867 participants was 46.96 ± 24.93, with 45.8% being female, 14.6% children, and 1.0% foreign nationals.

A viral agent was detected in 35 (4.0%) of the 867 individuals tested with the viral meningitis panel. Of the 35 patients with a viral agent, 26 (5.5%) were males, a proportion that was significantly higher than that in females (p = 0.015). The mean age was 40.9 ± 24.8 years in males and 43.0 ± 26.5 years in females, with no statistically significant difference between the groups (p=0.83). Of the 35 patients, 8 (6.3%) were children

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Table 1. Demographic and laboratory data of the study population.

		HSV-1		HSV-2		VZV	
	Total n	Positive n (%)	OR (95% CI)	Positive n (%)	OR (95% CI)	Positive n (%)	OR (95% CI)
Number	867	18 (2.1)		2 (0.2)		9 (1.0)	
Age (mean)	46.96±24.93	44.28±26.16		63.5±16.26		39±29.80	
Sex							
Female	397	6 (1.5)	1.67 (1.43- 1.91)	1 (0.3)	1.50 (-4.85- 7.85)	2 (0.5)	1.78 (1.44- 2.12)
Male	470	12 (2.6)		1 (0.2)		7 (1.5)	
Age Group							
Child	127	2 (1.6)	1.89 (1.73- 2.05)	0 (0.0)		3 (2.4)	1.67 (1.28- 2.05)
Adult	740	16 (2.2)		2 (0.3)		6 (0.8)	
Nationality							
Turkish	858	17 (2.0)	4.61 (4.10- 5 .13)	2 (0.2)	5.50 (-0.85- 11 .85)	9 (1.0)	4.22 (2.85- 5 .60)
Foreigner	9	1 (11.1)		0 (0.0)		0 (0.0)	
Years							
2019	41	2 (4.9)	4.11 (3.19- 5 .03)	0 (0.0)	3.50 (-15.56- 22 .56)	0 (0.0)	5.00 (4.33- 5 .67)
2020	89	3 (3.4)		1 (1.1)		0 (0.0)	
2021	159	1 (0.6)		0 (0.0)		1 (0.6)	
2022	177	3 (1.7)		0 (0.0)		0 (0.0)	
2023	211	3 (1.4)		1 (0.5)		6 (2.8)	
2024	190	6 (3.2)		0 (0.0)		2 (1.1)	
	Mumps Positive n (%)	Enterovirus Positive n (%)	OR (95% CI)	Parechovirus Positive n (%)	Total Positive n (%)	OR (95% CI)	p
Number	1 (0.1)	4 (0.5)		1 (0.1)	35 (4.0)		
Age (mean)	1±0.0	43.5±30.12		0±0.0	42.65±27.25		
Sex							
Female	0 (0.0)	0 (0.0)		0 (0.0)	9 (2.3)	1.74 (1.59- 1.90)	0.015
Male	1 (0.2)	4 (0.9)		1 (0.2)	26 (5.5)		
Age Group							
Child	1 (0.8)	1 (0.8)	1.75 (0.95- 2.55)	1 (0.8)	8 (6.3)	1.77 (1.63- 1.92)	0.161
Adult	0 (0.0)	3 (0.4)		0 (0.0)	27 (3.6)		
Nationality							
Turkish	1 (0.1)	4 (0.5)		1 (0.1)	34 (4.0)	4.37 (3.86- 4.88)	0.278
Foreigner	0 (0.0)	0 (0.0)		0 (0.0)	1 (11.1)		
Years							
2019	0 (0.0)	0 (0.0)	3.25 (0.86- 5 .64)	0 (0.0)	2 (4.9)	4.31 (3.75- 4.88)	0.164
2020	0 (0.0)	2 (2.2)		0 (0.0)	6 (6.7)		
2021	0 (0.0)	0 (0.0)		0 (0.0)	2 (1.3)		
2022	0 (0.0)	1 (0.6)		0 (0.0)	4 (2.3)		
2023	0 (0.0)	1 (0.5)		0 (0.0)	11 (5.2)		
2024	1 (0.5)	0 (0.0)		1 (0.5)	10 (5.3)		

Laboratory data : CSF Glucose (40-70 mg/dl); median (Rance) 65.62 (23-117.2), CSF Protein (15-45 mg/dl); median (Rance) 44.90 (2-264.9), CRP (0-5 mg/dl); median (Rance) 46.97 (0.26-373.34).

and 1 (11.1%) was a foreign national; no statistically significant differences were observed between children and adults (p = 0.161) or between Turkish citizens and foreign nationals (p = 0.278). The most frequently detected viral agents were HSV-1 (18 cases, 2.1%) and VZV (9 cases, 1.0%). The least frequently detected viral agents were mumps and parechovirus, each detected in one case. In children, the most common viral agent was VZV, detected in 3 (2.4%) cases; HSV-2 was not detected. In adults, HSV-1 was the most frequent, detected in 16 (2.2%) cases, whereas Mumps and Parechovirus were not detected. Among foreign nationals, only one case of HSV-1 was identified. When the viral agents were evaluated by year, the highest rates were observed in 2023 (5.2%, 11 cases) and 2024 (5.3%, 10 cases), while the lowest rate was observed in 2021 (1.3%, 2 cases). No statistically significant difference in the detection of viral meningitis agents between years was found (p = 0.164) (Table 1).

The distribution of viral meningitis cases by age group was as follows: 2 cases (5.7%) in the ≤1 year group, 3 cases (8.6%) in the 1-5 years group, 4 cases (11.4%) in the 6-17 years group,

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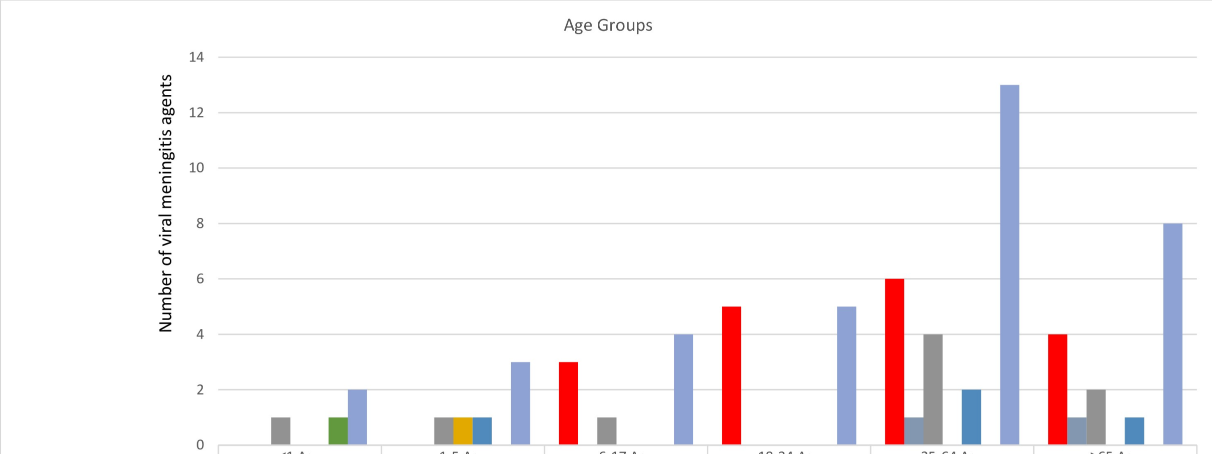

	≤1 Age	1-5 Age	6-17 Age	18-34 Age	35-64 Age	≥65 Age
HSV-1Positive, n	0	0	3	5	6	4
HSV-2 Positive , n	0	0	0	0	1	1
VZV Positive, n	1	1	1	0	4	2
MUMPS Positive, n	0	1	0	0	0	0
ENTEROVİRUS Positive, n	0	1	0	0	2	1
PARECHOVİRUS Positive, n	1	0	0	0	0	0
Total, n	2	3	4	5	13	8

Figure 1. Distribution of Hsv-1, Hsv-2, Vzv, Mumps, Enterovırus and Parechovırus by age group.

5 cases (14.3%) in the 18-34 years group, 13 cases (37.1%) in the 35-64 years group, and 8 cases (22.9%) in the ≥65 years group. The positivity rates for HSV-1, HSV-2, VZV, Mumps, Enterovirus, and Parechovirus in each age group are shown in Figure 1.

DISCUSSION

Viral meningitis is one of the most severe clinical conditions affecting individuals of all ages. In adults, viral meningitis is often self-limiting and may go undetected in many cases. However, in children and infants, serious complications such as high fever and mental retardation are common, and some cases may lead to death [8]. Viral meningitis can be associated with demographic factors, underlying conditions, causal agents, and treatment sensitivity, making regional information critical for its accurate and timely management. In this study, we aim to determine the frequency of viral meningitis cases and the current status of its causative agents in Muğla. In recent years, viruses have increasingly been recognized as significant causes of meningitis. Although the disease can initially be diagnosed based on clinical symptoms and routine biochemical tests, accurate identification of the pathogen is crucial. Therefore, molecular techniques are currently the gold standard for identifying the etiology of viral meningitis, as they not only allow for rapid and precise identification of the causative agent but also help reduce unnecessary antibiotic use and hospital stay duration [9].

The diagnosis of central nervous system viral infections has undergone a revolutionary change with the use of molecular diagnostic techniques to detect viral nucleic acids in cerebrospinal fluid (CSF); however, the etiology of up to 70% of CNS infections remains unknown [10]. Looking at studies on viral pathogen detection rates, a study conducted in Qatar between 2015 and 2019 found that 10.9% (732) of 6705 CSF samples tested positive for viral agents, with women accounting for 39.1% (286/732) of these cases [8]. In a 2023 study in Egypt, 19.0% (330) of 1735 CSF samples tested positive for viral agents, with 33.6% being women [11]. In a study conducted in Germany, similar to our study, 4.0% (125) of 3085 patients had viral nucleic acid detected [12]. In Turkey, studies have reported varying results; for instance, a study by Çiçek et al. [13] found that 32.4% (36) of CSF samples were positive, with 33.3% (12) being women. In contrast, a study by Soylar et al. [14] reported a viral detection rate of 2.0% (7) in 289 patients, with 5 being women. In this study, 4.0% (35 of 867) of individuals tested for viral meningitis via CSF PCR were found to have a viral agent. Of these, 5.5% (26) were male, a proportion that was significantly higher than that among females ($p = 0.015$). Although comparable to some reports, The low viral detection rate (4.0%) observed in our study was lower than that reported in many other studies. Several factors may account for this finding. First, the limited coverage of PCR panels used for cerebrospinal fluid (CSF) analysis may have contributed to this result because they may not include certain rare or newly identified neurotropic viruses, resulting in underdiagnosis. Second, the timing of sample collection is a critical factor. In viral meningitis, the viral load in CSF is generally higher during the early stages of the disease. Delayed patient presentation or late collection of CSF samples may reduce the detectability of viral nucleic acids, resulting in false-negative findings. Furthermore, the characteristics of the study population may be influential. Among patients undergoing CSF analysis with a clinical suspicion of viral meningitis, a proportion may actually have bacterial, fungal, or non-

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infectious etiologies (such as autoimmune encephalitis). In addition, CSF sampling and test requests that were made without sufficient clinical indication may have contributed to the relatively low detection rate observed in our study.

Several factors could explain the higher rate of viral meningitis in men compared to women, including biological differences between male and female immune systems; women generally have a stronger immune response, which could make them more resistant to some infections. This phenomenon can be explained by hormonal factors: estrogen has a positive effect on the immune system, while testosterone can suppress immune function. Moreover, men, particularly in younger age groups, may be more engaged in high-risk activities such as group sports, travel, or military service, increasing their exposure to viral infections. Social and environmental factors also play a role; men may be exposed to conditions that promote viral transmission, especially in high-risk areas or occupations.

The viral pathogen detection rates found in our study are lower than those reported in other studies in Turkey and abroad. This could be due to some of the samples we analyzed having been submitted to rule out acute viral meningitis in patients without prominent clinical symptoms. In Germany, a study by Kleines et al. [12] found that 36% of viral meningitis cases were caused by enterovirus (EV), 15% by herpes simplex virus (HSV), and 12% by varicella zoster virus (VZV). The highest incidence of EV infections was found in individuals aged 25-35, while HSV infections peaked in those aged 30-60, and VZV infections were most common in individuals younger than 30 and older than 70 [15]. Another German study reported that 1.3% (34/2624) of patients had VZV nucleic acid detected, 1.24% (37/2994) had HSV nucleic acid, and 0.4% (10/2364) had EV nucleic acid detected [12]. In a Danish study, EV was found in 39% (419) of 1066 cases, HSV-2 in 16% (171), and VZV in 15% (162) [16]. In the UK, McGill et al. [17] reported that enteroviruses were the most common cause of viral meningitis, accounting for 55% (127/231) of all cases. Abdelrahim et al. [10] identified enterovirus as the most common virus, accounting for 25% (60) of cases, followed by HHV-6 (7.9%, 19) and VZV (3.8%, 9). Enterovirus was most prevalent in the pediatric age group, particularly among children under 4 years old. HSV-2 was identified in two female patients aged 34-64 years. In Qatar, Mathew et al. [8] reported that EV was the most frequently detected virus, accounting for 68.7% (503/732) of cases. EV was the dominant infection across all age groups, and it was most common in children (85.1%, 428/503), followed by adolescents (8.94%, 45/503) and adults (5.77%, 29/503). In Turkey, studies by Çiçek et al. [13] found that enterovirus was the most common viral agent, detected in 69.4% (25) of cases, while Zeytinoğlu et al. [18] found Epstein-Barr virus (EBV) (4.35%) and enterovirus (3.37%) to be the most common. Akkaya et al. [19] reported enterovirus as the most common agent, detected in 6.5% (13) of cases, with the highest incidence in the 0-5 age group. Enteroviruses are the leading cause of viral meningitis worldwide. However, in our study, they were detected as the third most frequent viral agents, with one case in the 6-17 age group and two cases in the 35-64 age group. The most frequently detected viral agents in our study were HSV-1 (2.1%, 18 cases) and VZV (1.0%, 9 cases), which differ from the findings of European and local studies. Several factors could explain why HSV-1 is more frequently observed as a causative agent of viral meningitis than enteroviruses. Some cases diagnosed as meningitis may have had associated encephalitis. Additionally, HSV-1 may more frequently cause viral meningitis in immunocompromised individuals. Immunosuppressive treatment increases the likelihood that HSV-1 will affect the central nervous system and cause meningitis. In our study, the retrospective data we analyzed consisted of samples tested for viral meningitis by PCR. These samples are not always sent to clinics when meningitis is suspected, and clinicians may request screening for non-meningitis cases using the viral meningitis panel. For this reason, and unlike in other studies, enterovirus may have been the third most commonly detected virus in our results. Furthermore, our viral meningitis PCR diagnostic panel does not identify all enterovirus types, which may be an important consideration. Muğla is a major tourist destination in Turkey. It experiences an influx of domestic and international tourists throughout much of the year. This type of activity can increase the risk of contact with individuals who are HSV-1 carriers. Additionally, factors such as access to healthcare, language and cultural barriers, and delayed symptom reporting or referral may contribute.

The least frequently detected viral agents in our study were mumps and parechovirus, with only one case each. Mumps, which was once the most common cause of viral meningitis, was detected in only one case in our study, likely because the measles, mumps, and rubella (MMR) vaccine was introduced in Turkey in 2006.

In children, the most frequently observed viral agent was VZV (3 cases, 2.4%), whereas in adults HSV-1 was most common (16 cases, 2.2%). VZV is a highly contagious virus that is commonly observed in childhood. The virus can establish latency in neurons, which allows it to reactivate and affect the central nervous system later in life. In immunocompromised children, VZV may present more aggressively, potentially causing meningitis. Vaccination programs and other environmental factors can alter the prevalence of certain viral infections over time. Immunity to, or reduced exposure to classic viral meningitis agents, such as enteroviruses, may make other viruses, such as VZV, more apparent. The distribution of viral meningitis cases by age showed that 5.7% (2) were $\leq$1 years, 8.6% (3) were 1-5 years, 11.4% (4) were 6-17 years, 14.3% (5) were 18-34 years, 37.1% (13) were 35-64 years, and 22.9% (8) were $\geq$65 years. The highest incidence of EV, HSV-1, HSV-2, and VZV infections was observed in the 35-64 age group, while parechovirus infections were most common in the $\leq$1 year group, and mumps was most frequent in the 1-5 year

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group. In our study, viral pathogens were detected in 6.3% (8) of pediatric cases, although this rate is relatively low because of insufficient differentiation among patients. Clinically, some inflammatory and infectious diseases may mimic infectious meningitis because infectious meningitis has a broad definition, leading to a lower detection rate.

In a 2023 study in Egypt, the highest viral meningitis detection rate was observed in 2018, at 43.6% (144) [11]. A study conducted in Qatar found that the highest viral meningitis detection rate occurred in 2017, at 42.5% (311). In our study, the detection rate for viral agents was highest in 2024 (5.3%, 10 cases), followed closely by 2023 (5.2%, 11 cases). No statistically significant difference was found between the years ($p = 0.164$). Although no significant difference was observed between years, the increase in viral meningitis cases could be attributed to the relaxation of pandemic-related precautions (social distancing, mask use, hygiene measures) after 2022, as well as changes in healthcare-seeking behaviors. This may have contributed to a rise in viral infections, including viral causes of meningitis such as enteroviruses, HSV, and VZV. The resumption of normal activities following the pandemic likely increased the circulation of these viruses and, consequently, contributed to the rise in meningitis cases.

Limitations

We included only patients who underwent lumbar puncture and cerebrospinal fluid (CSF) PCR. This inclusion criterion may have missed cases with milder infections, potentially underestimating the true incidence of viral central nervous system (CNS) infections. Furthermore, only prespecified pathogens were tested, meaning that negative cases may be infected with organisms not included in our diagnostic algorithms. The lack of detailed clinical data, including clinical presentations, patients' comorbidities, and survival outcomes, as well as the limited scope of the PCR panel—covering only a restricted number of viral pathogens and potentially failing to detect rare or newly identified neurotropic viruses—constitutes additional limitations of the study.

CONCLUSION

This study is the first to report the molecular diagnosis of viral meningitis in Muğla. Our findings largely reflect the incidence of viral meningitis. Among the 867 patients who underwent CSF PCR for suspected viral meningitis, a viral pathogen was identified in 4.0% (35) of cases. This rate was 3.6% (27) in adults and 6.3% (8) in children, with no statistically significant difference between the two groups. The most commonly identified pathogens were HSV-1, VZV, and EV, which is consistent with global literature; however, the most frequently identified pathogen was HSV-1 rather than EV, which we believe may be due to encephalitis accompanying some cases presenting with suspected meningitis. The use of molecular methods to identify viral pathogens plays a crucial role in patient management. Early and accurate identification of viral pathogens improves the likelihood of effectively managing viral meningitis by enabling timely administration of antiviral agents. Moreover, diagnosing a specific virus in cases of viral meningitis can reduce inappropriate antibiotic use, the duration of hospital stays, and hospital admission costs. Further studies are needed to determine the frequency of pathogens in Turkey and to obtain sufficient epidemiological data.

Ethics Committee Approval: This study was approved by the Ethics Committee of the Muğla Sıtkı Koçman University Faculty of Medicine, Department of Medical Sciences (Decision no: 163, Date: 09.12.2024).

Informed Consent: Since our article is retrospective, patient consent is not required.

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