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ORIGINAL ARTICLE

Viral meningitis: clinical-epidemiological study of a pediatric epidemic outbreak

Meningitis viral: estudio clínico-epidemiológico de un brote epidémico pediátrico

Meningite viral: estudo clínico-epidemiológico de um surto epidêmico pediátrico

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ABSTRACT

Introduction: infections of the central nervous system constitute a global health problem, with an increase in their incidence and prevalence in pediatric ages observed in recent decades. **Objective:** describe the clinical-epidemiological aspects of children with viral meningitis during the 2023 epidemic outbreak. **Method:** an observational, descriptive and retrospective study was carried out in 181 children in an outbreak of viral meningitis at the "Hermanos Cordové" Pediatric Hospital in Manzanillo, Granma province, Cuba. To collect the information, a form was used with the variables: age, sex, risk factors, signs and symptoms, cellularity in the cerebrospinal fluid and time of the lumbar puncture, taken from the medical records of said patients. **Results:** the male sex predominated with 111 patients (61.3%). The most common age group in both sexes was one to five years old with 79 patients (43.6%). The predominant risk factor was overcrowding with 104 children for 57.5%. The most frequent symptoms were fever in 165 children (91.2%), followed by vomiting (152 patients with 84%) and headache (in 115 infants with 63.5%), both with a value of p>0.05. The predominant cellularity in the cerebrospinal fluid study was between 101 and 499 cells for 57.5% of the total study population. **Conclusions:** viral meningitis is an infectious disease that is on the rise in pediatric ages. Its main clinical picture is characterized by high fever, projectile vomiting, headache and neck stiffness. Even in epidemic outbreaks, the study of cerebrospinal fluid is the complementary test of choice for diagnosis.

Keywords: infections; viral meningitis; virus; children; viral diseases; viral outbreak

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RESUMEN

Introducción: las infecciones del sistema nervioso central constituyen un problema de salud mundial, observándose en las últimas décadas un incremento de su incidencia y prevalencia en edades pediátricas. **Objetivo**: describir los aspectos clínico-epidemiológicos de niños con meningitis viral durante el brote epidémico de 2023. **Método**: se realizó un estudio observacional, descriptivo y retrospectivo en 181 niños en un brote de meningitis viral en el Hospital Pediátrico "Hermanos Cordové" de Manzanillo, provincia Granma, Cuba. Para la recolección de la información se utilizó un formulario con las variables: edad, sexo, factores de riesgo, signos y síntomas, celularidad en el líquido cefalorraquídeo y tiempo de realizada la punción lumbar, tomadas de las historias clínicas de dichos pacientes. **Resultados**: predominó el sexo masculino con 111 pacientes (61,3 %). El grupo de edad más frecuente en ambos sexos fue el comprendido de uno a cinco años con 79 pacientes (43,6 %). El factor de riesgo predominante fue el hacinamiento con 104 niños para un 57,5 %. Los síntomas más frecuentes fueron la fiebre en 165 niños (91,2 %), seguido de los vómitos (152 pacientes con un 84 %) y la cefalea (en 115 infantes para un 63,5 %), ambos con valor de p>0.05. La celularidad que predominó en el estudio del líquido cefalorraquídeo fue la comprendida entre 101 a 499 células para un 57,5 % del total de la población de estudio. **Conclusiones**: la meningitis viral es una enfermedad infecciosa que se encuentra en ascenso en las edades pediátricas. Su cuadro clínico principal se caracteriza por fiebre alta, vómitos en proyectiles, cefalea y rigidez nucal. Aun en brotes epidémicos, el estudio del líquido cefalorraquídeo figura como el examen complementario de elección para su diagnóstico.

Palabras claves: infecciones; meningitis viral; virus; niños; enfermedades virales; brote viral

RESUMO

Introdução: as infecções do sistema nervoso central constituem um problema de saúde global, com aumento da sua incidência e prevalência em idades pediátricas observado nas últimas décadas. **Objetivo:** descrever os aspectos clínico-epidemiológicos de crianças com meningite viral durante o surto epidêmico de 2023. **Método:** foi realizado um estudo observacional, descritivo e retrospectivo em 181 crianças em surto de meningite viral no Hospital Pediátrico "Hermanos Cordové" em Manzanillo, província de Granma, Cuba. Para a coleta das informações foi utilizado um formulário com as variáveis: idade, sexo, fatores de risco, sinais e sintomas, celularidade do líquido cefalorraquidiano e horário da punção lombar, retirados dos prontuários dos referidos pacientes. **Resultados:** predominou o sexo masculino com 111 pacientes (61,3%). A faixa etária mais comum em ambos os sexos foi de um a cinco anos com 79 pacientes (43,6%). O fator de risco predominante foi a superlotação com 104 crianças para 57,5%. Os sintomas mais frequentes foram febre em 165 crianças (91,2%), seguida de vômitos (152 pacientes com 84%) e cefaleia (em 115 lactentes com 63,5%), ambos com valor de p>0,05. A celularidade predominante no estudo do líquido cefalorraquidiano foi entre 101 e 499 células para 57,5% da população total do estudo.**Conclusões:** a meningite viral é uma doença infecciosa que está em ascensão na idade pediátrica. Seu quadro clínico principal é caracterizado por febre alta, vômitos em projéteis, dor de cabeça e rigidez de nuca. Mesmo em surtos epidêmicos, o estudo do líquido cefalorraquidiano é o exame complementar de escolha para o diagnóstico.

Palavras-chave: infecções; meningite viral; vírus; crianças; doenças virais; surto viral

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INTRODUCTION

Acute meningitis, considered as a medical emergency, is an infectious pathology of the Central Nervous System (CNS) that involves the meninges covering the brain and spinal cord. The origin may be multicausal, infectious or non-infectious. The most frequent type of pathogen is determined by the patient's age, comorbidities and immunization status.(1)

Aseptic meningitis or lymphocytic meningitis are those in which it is not possible to isolate a pathogenic agent with usual bacterial culture techniques in which leukocytosis or pleocytosis may or may not be observed. They are also known as clear fluid meningitis, because a cerebrospinal fluid (CSF) is observed which is not purulent or cloudy like those of bacterial origin.(2)

The etiology is very varied and includes viral, bacterial, fungal and mycobacterial infections. Viral meningitis (VM) is responsible for 80% of cases, mainly due to enteroviruses (85%-95%, especially echoviruses), followed by herpesviruses, parechoviruses, respiratory viruses and arboviruses in endemic areas. Less frequent are epidemic mumps, rubella, parainfluenza, influenza, hepatitis A and B, human immunodeficiency virus (HIV), rabies, some respiratory viruses such as influenza, metapneumovirus, respiratory syncytial virus (RSV) or adenovirus and rotavirus.(3,4,5)

Enteroviruses are the most frequently reported in Europe in recent years. Herpesviruses produce severe infections and are the most common cause of necrotizing encephalitis in 85% of cases. Others in tropical areas are: dengue virus, chikungunya, zika and other arboviruses of worldwide distribution with higher incidence in tropical climates transmitted by arthropod bites.(6)

Enteroviruses are neurotropic viruses and produce varied clinical pictures. Man is the only reservoir that is infected by the fecal-oral and respiratory routes.(7) They are usually transmitted by the fecal-oral route. Viral particles bind to specific enterocyte receptors, cross the intestinal mucosa and reach Peyer's patches, where they replicate. Transmission through inhalation of infected droplets is less frequent.

In either form of transmission, primary viremia occurs, which allows the virus to spread to other organs such as the liver and spleen, where it replicates again, with secondary viremia occurring later. In both periods of viremia, the virus can reach the CNS, although the mechanism by which it achieves this is still unknown. Climatic and geographical conditions, exposure to animals, among other factors, predispose a given population to the prevalence of some viruses.(8, 9)

MV has a better prognosis compared to bacterial meningitis; the reason lies in the pathophysiology, since it will not produce such extensive inflammation, or such intense neuronal damage. Therefore, they have a much more benign clinical presentation than bacterial meningitis and are self-limiting.(10)

In the United Kingdom, reports have increased sevenfold in 2013 over 2004. In 2018in Austria, tick-borne encephalitis reached an all-time high with 154 cases. In North America (USA), cases are more frequent, especially those caused by Enterovirus, in both children and adults. In South America, the most common are dengue virus, chikungunya, zika and eastern equine encephalitis virus.(11)

In the year 2021, in Cuba, 12 deaths of the male sex due to MV were registered; by 2022 this figure rose to 17 cases, while the female sex in 2021 reported 12 deaths and, in 2022, 12 deaths due to this disease. In 2023, a total of 25 victims were recorded, 13 males and 12 females.[12,13]

Surveillance of notifiable diseases (NDD), including meningitis, has been established in Cuba since 1961. The information available on some epidemiological aspects of these diseases in our country is not abundant, since most of the published research and reports on this interesting subject are very often focused on an agent in a specific region of the country and do not provide a holistic view of these diseases.[14]

The high incidence of infectious diseases and the need for the medical community dedicated to pediatrics to provide higher levels of healthiness to their patients. In addition to the usefulness that preventive actions could have in this sense, are the issues that encouraged the authors to conduct the present study, whose foundation could be based on the following research question: How were the clinical and epidemiological aspects characterized in patients with VM treated at the Pediatric Hospital "Hermanos Cordové" during the epidemic outbreak of 2023?

Therefore, the present research aims to describe the clinical-epidemiological aspects of children with viral meningitis during the epidemic outbreak of 2023.

METHOD

An observational, descriptive and retrospective study was carried out. The population consisted of 181 patients with a diagnosis of VM treated at the "Hermanos Cordové" Provincial Pediatric Teaching Hospital of Manzanillo, Granma province, Cuba.

Those patients with clinical and cytochemical diagnosis of viral meningitis by means of lumbar puncture (LP) and the study of the positive cerebrospinal fluid (CSF), within the study period certified by the provincial center of Hygiene and Epidemiology; from September 23 to October 10, 2023 were included.

Diagnostic criteria for viral meningitis in the CSF study: the appearance of the fluid should be clear as rock water, cellularity not exceeding 500 cells/mm^3; normal or slightly increased proteins and normal glycorrhachia.

Samples that were not useful, failed or traumatic LP were excluded. Clinical-epidemiological variables were evaluated as follows. Sex: (female and male); Age: (under 1 year; 1 to 5 years; 6 to 10 years and over 10 years); Risk factors such as: overcrowding, upper respiratory infection (URI) and previous acute diarrheal disease (ADE); Symptoms and signs, CSF cellularity and time elapsed from the onset of symptoms and the performance of the LP for CSF study.

For the collection of information, a form was used with the variables that were the object of the study in the clinical histories of the patients with a clinical and laboratory diagnosis of VM. For the analysis of the results it was used the version 24 of the program SPSS, which allowed the processing of the data and calculation of the absolute and relative frequencies. The formulated hypothesis was tested using the following approach:

H_0: Symptoms and signs in VM did not manifest with similar frequency in all age groups.

H_1: Symptoms and signs in VM manifested with similar frequency in all age groups.

The Chi-square test was used for this purpose. Data collection was obtained from clinical records under the principle of confidentiality.

The research was carried out in compliance with the basic ethical principles: autonomy, beneficence, nonmaleficence and justice. The study was carried out with the approval of the ethics committee and scientific council of the "Hermanos Cordové" Provincial Pediatric Teaching Hospital. The information obtained was only used for scientific purposes.

RESULTS

The highest number of cases was in the male sex, with 111 children (61 %). The age group that predominated in both sexes was between 1 and 5 years of age: males with 49 cases for 16.6 % and 30 females for 27.1 % proportionally (Table 1).

Table 1: Patients diagnosed with viral meningitis according to age and sex.

Age Groups	Female		Male		Total	
	No.	%	No.	%	No.	%
Under 1 year old	13	7,2	19	10,5	32	17,7
1-5 years old	30	16,6	49	27,1	79	43,6
6-10 years old	21	11,7	34	18,8	55	30,4
Older than 10 years	6	3,3	9	5,0	15	8,3
Total	70	38,7	111	61,3	181	100,0

Source: medical records

The presence of risk factors was identified in 167 patients, representing 92.3% of the study universe, with overcrowding being the most relevant in 104 patients (57.5%). (Table 2)

Table 2: Risk factors present in patients diagnosed with viral meningitis.

Risk factors	No.	%
Overcrowding	104	57,5
High ARI	40	22,1
Previous EDA	23	12,7
No risk factors	14	7,7
Total	181	100,0

ARI: acute respiratory infection; ADE: acute diarrheal disease
Source: medical records

The predominant symptom was fever with 165 patients for 91.2 %, the same was present in all age groups followed by vomiting in 152 children for 84 %, which were frequent in the age groups 1-5 years and 6-10 years, both with value of p>0.05, which showed heterogeneity in the age groups, so the null hypothesis was not rejected.(Table 3)

Headache was manifested in 115 patients for 63.5 %, and was marked in the 6-10 years group with 52 children (28.7 %), followed by the group older than 10 years with 13 patients (7.2 %). It is important to highlight that headache, nuchal rigidity, bulging fontanel and irritability showed values of p<0.05, which translated homogeneity in all age groups, therefore, the null hypothesis was rejected. A significant number of patients presented more than one symptom and/or sign, as can be seen in Table 3.

Table 3: Patients diagnosed with viral meningitis according to symptoms, signs and age groups.

Symptoms and signs	Ages groups								Total*		Value p
	< 1 year (n=32)		1-5 years (n=79)		6-10 years (n=55)		>10 years (n=15)				
	No.	%	No.	%	No.	%	No.	%	No.	%	
Fever≥38,5°C	29	16,0	70	38,7	53	29,3	13	7,2	165	91,2	>0,05
Vomiting	25	13,8	68	37,6	47	26	12	6,6	152	84,0	>0,05
Cephalea	-	-	50	27,6	52	28,7	13	7,2	115	63,5	<0,05
Nuchal rigidity	-	-	23	12,7	45	24,9	14	7,7	82	45,3	<0,05
Bulging fontanel	20	11,0	-	-	-	-	-	-	20	11,0	<0,05
Irritability	24	13,3	32	17,7	30	16,6	4	2,2	90	49,7	<0,05

*Percentage calculated based on the total number of children (n=181)
Source: medical records

The CSF study performed in 100% of the patients showed a cellularity between 101 and 499 leukocytes present in 104 patients, for 57.5% (Table 4).

Table 4: Cellularity in the cerebrospinal fluid of patients diagnosed with viral meningitis related to the time of lumbar puncture.

Time after PL	Cellularity in the CSF									
	<100		101-499		1 000		>1000		Total	
	No.	%	No.	%	No.	%	No.	%	No	%
≤5 days	30	16,6	79	43,6	24	13,3	12	6,6	145	80,1
> 5 days	4	2,2	25	13,8	4	2,2	3	1,7	36	19,9
Total	34	18,8	104	57,5	28	15,5	15	8,3	181	100,0

CSF: cerebrospinal fluid; LP: lumbar puncture
Source: medical records

DISCUSSION

Meningitis constitutes a medical emergency with great economic and social implications, which requires early diagnosis and timely treatment to avoid complications in pediatric ages, which often trigger disabling factors for facing adult life.

The findings of the present research were concordant with the study of Sarmiento[15] in 2022, in Holguín, which shows a prevalence of viral meningitis in the male sex, with 72.41 %, in a ratio between sexes of 3:1; which does not agree with the age group, where the predominant was adolescents (31.03 %), followed by preschoolers and schoolchildren with 27.58 % each.

In another study conducted in 2020 by Erazo[11] in Antioquia, Colombia, it is reported that the highest incidence occurred in the group between 5-9 years, followed by the group of 1-4 years, while Aldás Serrano[16] in 2019, found that the most affected age group was between 10 and 14 years and with a predominance of male sex (61.5 %).

For his part, Leguizamón, et al.[17] in 2017, in a research conducted at the National Hospital of Paraguay, states that the most affected age group was children under five years of age, with 71 cases for 41%, concordant with the present result.

In the author's opinion, it was observed that most of the published studies showed a predominance of the male sex. Although an explanation for this has not been found, this fact may be supported by the information that boys have a greater environmental exposure than girls do and this predominance indicates that this finding should be taken into account from the point of view of the surveillance of this entity.

According to age, it is appropriate to point out that infants apart from being protected by breastfeeding have elevated levels of transplacental immunoglobulin G, which begins to decline after the first six months of life, so that the transient hypogammaglobulinemia of infancy is a contributing factor to the predominance of VM in preschoolers. They are more susceptible to common infections. In addition, iron deficiency is common, which is multifactorial, where there is also an accelerated growth rate. It is known that iron deficiency has negative consequences on the immunocompetence of these children.

Overcrowding is a common risk factor in infectious diseases, because it generates unfavorable hygienic-sanitary conditions, increases direct contact between people, with poor ventilation, poor air quality, and greater stress and therefore the respiratory transmission of these infections.

According to Barreras Lastre, et al.[18] in their research in 2016, exposes that 60% of patients with MV had overcrowding as the main risk factor. Likewise, Peña Aldana,et al.[19] in 2017 shows that 25.8 % were exposed to overcrowding. These results coincided with those found by the authors of the present investigation.

Regarding symptoms, Palacio Restrepo,et al.[1] in 2021 reports that 30% of patients with a diagnosis of MV present the classic triad of fever, vomiting and neck stiffness. A study by Chen,et al.[20] in 2021, which included 23 neonates, reports that all had fever (100 %) and some rash (39.1 %). The incidence of aseptic meningitis was high (91.3%), but only a small proportion (28.6%) had leukocytosis in the CSF. The positive value for nucleic acid detection in CSF was significantly higher than in throat swab (91.3 % vs. 43.5 %, P=0.007).

From this perspective, Patiño-Niño, et al.[21], in their research shows that the most reported symptom at admission is fever in 78.6 %, followed by emesis in 61.9 % and sensory alterations in 52.4 %. While Araya,[22] in his study mentions that headache, altered state of consciousness and fever were the most frequently observed clinical manifestations.

According to the authors' experience, it should be emphasized that fever is common in infectious and inflammatory processes; especially if accompanied by headache and vomiting, known as the meningeal triad, and irritability is common, especially in young children, as an expression of pain and discomfort. Relevant elements that make it necessary to suspect, from primary health care, the presence of infections of the central nervous system. Most authors agree that fever is a distinctive symptom of CM, which coincides with the experience of the authors of this study.

In line with the reviews consulted and the experience of the authors of the present study, it is demonstrated that in CM there is a predominance of lymphocytic cellularity in the CSF with negative bacteriological cultures. The predominance in the series of the leukocyte formula is dependent on the immunological status of the child, the type of germ and the time of evolution of the disease.

The main limitation of the study was the impossibility of performing a virological examination in 100% of the cases in the study. However, this weakness is a source of inspiration for future research.

The social relevance of this research is determined by the deleterious incidence of a health problem such as VM, precisely in the mitigation of consequences in which it frequently occurs. Loss of quality of life, death, disability, stigmatization, social and group pressure, increased economic expenditure; clarifying the most vulnerable points, towards which the research-health care work should be oriented, so as to cover the patients and the care unit as a social group and the socioeconomic context in which they live and which in turn constitutes the author's motivation.

CONCLUSIONS

Viral meningitis is an infectious disease that is on the rise in pediatric ages, high fever, projectile vomiting, headache and nuchal rigidity characterize its main clinical picture. Even in epidemic outbreaks, the study of cerebrospinal fluid is the complementary test of choice for its diagnosis and its cellularity is variable according to the time of evolution of the disease.

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