REVIEW ARTICLE

# Central nervous system infections and their management in the Emergency Department.

*Luis Omar López-Hurtado[1], José Antonio Gómez-Reyna[2], Lucia Díaz-Morejón[3], Lázaro Ernesto Díaz-Acosta[4], Hisleidys Hernández-González[5].*

**Abstract**
The probability that a child has a central nervous system (CNS) infection is a constant concern of the doctors in the emergency department. Clinical manifestations raising suspicion of CNS infection will depend on the patient's age, evolution time before being seen by the doctor, the etiologic agent and the specific disorder, among others. In infants, the association of impaired consciousness with irritability and drowsiness, fever, "bulging" fontanel, food rejection, seizures, petechiae and malaise are elements to consider. In older children, a history of fever associated with headaches, vomiting and stiff neck (meningeal syndrome) is frequently reported. The most important complementary test for diagnosis is the study of the cerebrospinal fluid (CSF), which can also suggest the probable outcome of the infection.

**Key words**
Childhood CNS infection, CSF, meningoencephalitis, meningococcemia

## ■ INTRODUCTION

The probability that a child has a central nervous system (CNS) infection is a constant concern of the doctors in the emergency department. The severity of the clinical manifestations and possibilities of sequels, permanent or not, undoubtedly justify this concern [1]
Although it is very important to understand the pathophysiology of these diseases that cause pathological changes, the examinations which may be required, and the specific treatment needed, only some of the many situations, encountered by the doctor in emergency medical care are presented and their previous knowledge allows making decisions "with promptness and more ease" [1,3].

## Clinical manifestations raising suspicion of CNS infection in children

Clinical manifestations will depend on the patient's age, evolution time before being seen by the doctor, the etiologic agent and the specific disorder, among others.
In infants, the doctor's suspicion is probably the key factor that determines the diagnosis. However, the association of impaired consciousness with irritability and drowsiness, fever, "bulging" fontanel, food rejection, seizures, petechiae and malaise are elements that raise suspicion of CNS infections [2].
In older children, a history of fever associated with headaches, vomiting and stiff neck (meningeal syndrome) is frequently reported. Of course, photophobia, focal motor deficit, seizures and impaired consciousness, among others may be present [10].

## Etiology

The most common cause of CNS infections are bacteria and viruses. When they are caused by bacteria, most often they occur as meningoencephalitis, predominantly with meningeal involvement (bulging fontanel, fever, irritability and general malaise in the younger; headache, vomiting and stiff neck in older children).
When infections are caused by a virus, they usually present with brain predominance (impaired consciousness, seizures and focal motor defect) [7].
Regarding vaccination and preventive measures, although the frequency of different bacteria as etiological agents has changed; Haemophilus influenzae, pneumococcal and meningococcal infections, for which vaccines exist, still have

1 Corresponding author: MD, Pediatrician, Cleopatra White Clinic, Belize City, Belize. E-mail: luisomar66@yahoo.com

2 MD, General Medicine Specialist, Karl Heusner Memorial Hospital(KHMH), Belize City, Belize

3 MD, Specialist in Pediatrics, Paquito González Cueto Teaching Hospital, Cienfuegos, Cuba

4 MD, General Medicine Specialist, Cleopatra White Clinic, Belize City, Belize

5 Graduate nurse, Paquito González Cueto Teaching Hospital, Cienfuegos, Cuba

the highest frequency in the population [1.8].
Some particular conditions cause other agents to generate the infections. Among these immunosuppressed patients with AIDS, head trauma with open fractures neurosurgical treatment, or the neonatal period may be mentioned to cite a few examples [11].
Among viruses, enteroviruses should be considered and the possibility of herpes encephalitis, always kept in mind.

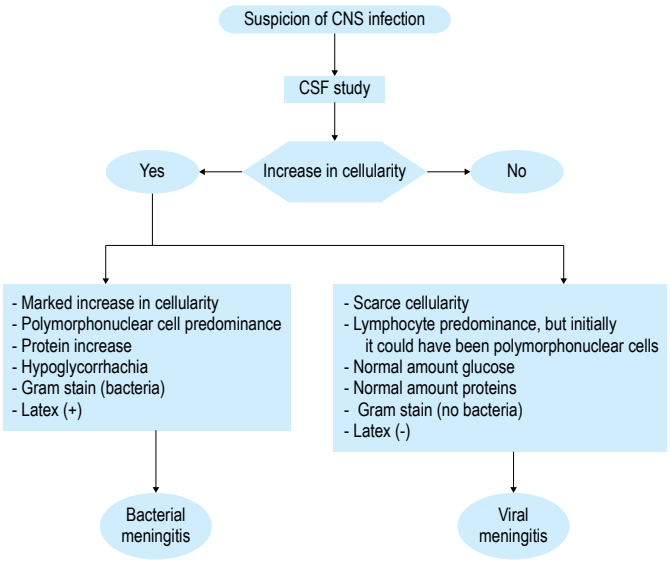
## How do CNS infections present clinically?

The most common forms of presentation in the emergency department are meningoencephalitis, predominantly in the brain or meninges and brain abscesses (much less frequently), although they are not the only forms of presentation [4].

## What is the most important complementary test for diagnosis?

The answer is the study of cerebrospinal fluid (CSF), but there might be elements that advice deferring it:
• Skin lesions on the area of lumbar puncture, which limit its peprformance (malformations, infections).
• Signs of increased intracranial pressure, especially when abscesses, empyema, etc have not been ruled out by imaging.
The results found by studying the CSF may leave little margin for error on whether the meningoencephalitis is of viral or bacterial origin (See Diagram below), however, the results are not always so typical.

## Diagnostic flow chart based on the study of cerebrospinal fluid




A bacteriological study should be indicated in patients with suspected CNS infection. If available and necessary, virologic studies should be performed. Other studies may also be useful to determine the etiology, but they are not often available.
Some investigations may be indicated for the differentiation of CNS infections and other processes such as leucosis, tumors, inflammatory post-infectious processes and demyelinating diseases.

## Aspects taken into account for interpreting CSF findings in the emergency room

### CSF pressure

Intracranial pressure cannot be identified by drip rate only; performance of manometry with an adequate technique can determine the intracranial pressure value, which is increased, especially in bacterial processes.

### Appearance

The appearance of CSF turbidity is determined primarily by cellularity (over 100 cells), and proteins (more than one gram). On rare occasions, the CSF can appear reddish suggesting the presence of blood. In such cases, CSF must be collected in three test tubes to determine whether the red blood cells (RBC) are crenated or not, and should further be centrifuged to determine if the supernatant is xanthochromic. In traumatic punctures (no open bleeding to CSF), CSF becomes clear in the last 2 tubes, crenated RBCs are few and the supernatant after centrifugation is clear and not xanthochromic.

### Cellularity

In bacterial meningoencephalitis, an increase by thousands is expected in the cell number, but in some patients in whom lumbar puncture is performed early and the micoorganism is very aggressive, the CSF may not appear to have cells and yet within hours, thousands of cells appear. In bacterial infections, low cellularity upon evaluation is a poor prognostic factor.

### Leukocyte prevalence

Bacterial processes are characterized by polymorphonuclear cells predominating in the CSF; however in the early stages of viral infections, there may be a predominance of polymorphonuclear cells and not lymphocytes as occurs in most occasions.
In these cases it is very helpful to consider the epidemiology, the general condition of the patient, the intensity of clinical manifestations, absence of hypoglycorrhachia, no increase in CSF protein and Gram and latex tests that do not support a bacterial process. Of course, the clinical judgment and experience of the doctor are the main tool for decision making.

### Glycorrhachia

In meningoencephalitis and other infections, especially bacterial ones, glucose may be low (hypoglycorrhachia). Determining the glucose level in CSF (normal, or decreased) depends on the ratio of glucose in the CSF with respect to the blood; therefore, hypoglycorrhachia or normal glucose in CSF can never be determined without simultaneously performing glycemia. (Normally, levels should be about 50% of blood glucose.)

Other studies such as complete blood count with differential, erythrocyte sedimentation, coagulation, blood culture, assessment and diagnosis of probable bacterial origin such as otitis, CNS fistulas or other should be taken into account when making a diagnostic and therapeutic decision. The CSF Gram study, is very useful in diagnosing the source of CNS infection, but sometimes bacteria cannot be observed, despite a bacterial origin: [4, 5.6]

- partially treated bacterial meningoencephalitis (modified)
- agents that are difficult to obtain
- parameningeal infection not "open" to CSF (abscess, empyema).

## Prognosis in the emergency department

Patients with bacterial meningoencephalitis should be considered as having severe life-threatening disease and all measures consistent with this possibility must be taken and explained to the family.

In patients with viral meningoencephalitis, the possibility of unfavorable evolution must always be taken into account; however, on some occasions, the clinical manifestations are mild and probable satisfactory evolution can be presumed and therefore the patients might not be considered in critical condition.

A patient with probable viral infection, who has general malaise or other sign or symptom of poor prognosis, should be considered and treated as having herpes encephalitis [8.9,12]

## Clinical manifestations of poor prognosis in patients with CNS infections

- Signs of increased intracranial pressure (headache, vomiting and papilledema), especially if associated with bradycardia and/or paralysis of the external rectus muscle of the eye, which causes inward deviation of the eye,
- Disorders of consciousness,
- High fever,
- Marked increase in CSF cellularity, or scarce cellularity in a bacterial infection,
- Infection in immunocompromised patients,
- Petechiae and other manifestations of bleeding disorders and shock.

## ■ CONCLUSIONS

The most important diagnostic tool in the diagnosis of CNS infection is the study of the CSF. Depending on the results, prompt adequate treatment may be established and prognosis suggested.

## ■ REFERENCES

1. Makwana N, Riordan FA. Bacterial meningitis: the impact of vaccination. CNS Drugs 2007; 21: 355-366.

2. Schut ES, de Gans J, van de Beek D. Community-acquired bacterial meningitis in Pract Neurol 2008; 8: 8-23.

3. Velasco F, Zarranz JJ. Enfermedades infecciosas del sistema nervioso central. En: J.J. Zarranz ed. Neurología. Elsevier, España 2008: 281-335.

4.- Matas L, Alonso-Tarrés C, Echevarría JM. Diagnóstico de las enfermedades infecciosas. En: Ausina V y Moreno S (eds). 2006. Tratado SEIMC de Enfermedades Infecciosas y Microbiología Clínica. Editorial Médica Panamericana, Buenos Aires, Madrid.

5.- Griffin D. Encefalitis, mielitis y neuritis. En: Mandell GL, Bennet JE y Dolin R (eds). 2008. Enfermedades infecciosas. 2007. Principios y práctica. Elsevier, España. Madrid.

6. Chaudhuri A, Martinez-Martin P, Kennedy PG, Andrew Seaton R, Portegies P, Bojar M, et al. EFNS guideline on the management of community-acquired bacterial meningitis: report of an EFNS Task Force on acute bacterial meningitis in older children and adults. Eur J Neurol 2008;15 :649-59

7. Swartz MN. Meningitis: bacterial, viral, and other. In: Goldman L, Ausiello D, eds. Cecil Medicine. 23rd ed. Philadelphia, Pa: Saunders Elsevier; 2008: chap 437.

8. Prober CG, Dyner L. Central nervous system infections. In: Kliegman RM, Behrman RE, Jenson HB, Stanton BF, eds. Nelson Textbook of Pediatrics. 19th ed. Philadelphia, Pa: Saunders Elsevier; 2011:chap 595.

9. Centers for Disease Control and Prevention. Meningitis Available at: http://www.cdc.gov/meningitis/index.html Accessed on: Oct. 15 and 16, 2012

10. Mayo Cinic. Meningitis.Symptoms. Available at: http://www.mayoclinic.com/health/meningitis/DS00118/DSECTION=symptoms Accessed on: Oct. 15 and 16, 2012

11.National Institute of Neurological Disorders and Stroke. NINDS Meningitis and Encephalitis Information Page. Available in Spanish at: http://espanol.ninds.nih.gov/trastornos/meningitis_y_encefalitis.htm Accessed on: Oct. 15 and 16, 2012

12.Healthy Children.org. American Academy of Pediatrics. Meningitis. Source: "Caring for Your Baby and Young child". Available in Spanish at: http://www.healthychildren.org/spanish/health-issues/conditions/head-neck-nervous-system/paginas/meningitis.aspx Accessed on: Oct. 15 and 16, 2012.