EAS Journal of Anaesthesiology and Critical Care
Abbreviated Key Title: EAS J Anesthesiol Crit Care
ISSN: 2663-094X (Print) & ISSN: 2663-676X (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-7 | Issue-4 | Jul-Aug-2025 | DOI: https://doi.org/10.36349/easjacc.2025.v07i04.004

Original Research Article

Meningoencephalitis in Intensive Care in a Context with Limited Resources: Diagnostic Issues, and Therapeutic Challenges

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Article History
Received: 22.06.2025
Accepted: 18.08.2025
Published: 23.08.2025

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: ***Introduction:*** Meningoencephalitis (ME) represents a serious neuroinfectious emergency, particularly in resource-limited countries where etiological diagnosis is often delayed or impossible. In sub-Saharan Africa, specific data in resuscitation are few. The objective was to describe the clinical profile, diagnostic and therapeutic challenges of ME in intensive care at the University Hospital of Angré. ***Methods:*** We conducted a 24-month retrospective observational study on patients admitted for ME, defined according to recognized clinical criteria, and who had received a lumbar puncture. Clinical data and standard analyses of the CSF were collected. The data was analyzed in a descriptive and univariate way with Epi Info TM. ***Results:*** The cohort included young patients (median age 13 years), with high severity at admission and significant mortality (70%). The lumbar puncture, performed in 63% of cases, showed an inflammatory CSF, but without etiological agent identification, notably due to the lack of advanced molecular tools. Co-infections and comorbidities, including HIV, complicated management. ***Conclusion:*** This study highlights the major diagnostic limitations and a high mortality rate, highlighting the urgency of improving diagnostic capabilities and therapeutic protocols in resource-limited settings to reduce morbidity and mortality associated with EM.

Keywords: Meningoencephalitis, Intensive care, Neurological diagnostic procedures, Developing countries.

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INTRODUCTION

Meningoencephalitis (ME) represents a major neuro-infectious emergency, characterized by simultaneous acute inflammation of the cerebral parenchyma and meninges. Their clinical picture usually associates disorders of consciousness, convulsions, and cerebrospinal fluid (CSF) abnormalities, with a vital and functional prognosis rapidly engaged [1]. In countries with limited resources, diagnostic and therapeutic challenges are particularly pronounced. The diagnosis is mainly based on the clinical evaluation and microbiological analysis of the CSF. However, conventional methods are often insensitive, particularly due to frequent prior antibiotic therapy which reduces the ability to identify infectious agents by culture. Moreover, limited access to modern molecular biology techniques, such as multiplex PCR or metagenomics, restricts diagnostic accuracy, often leading to empirical, delayed or inappropriate treatments, a factor that exacerbates morbidity and mortality [1, 2].

The California Encephalitis Project reported that approximately 62% of encephalitis remains without identified etiology, illustrating the diagnostic complexity inherent in these pathologies [3]. This observation is accentuated in contexts with limited resources, where the deficit in technical means is more marked. Moreover, the affected population in these regions is often younger, with a strong pediatric predominance, and comorbidities such as HIV play a major role in the severity and prognosis of ME [4].

However, specific data concerning meningoencephalitis in patients admitted to intensive care in West Africa, and particularly in Côte d'Ivoire, remain rare, often old, and poorly adapted to the critical reanimatory context. This gap limits epidemiological and clinical knowledge and hinders the optimization of

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management strategies adapted to these populations [5]. In this context, our study aims to describe the epidemiological, clinical, biological and evolutionary characteristics of patients suffering from ME admitted to the multipurpose intensive care unit at the University Hospital Center of Angré (Abidjan).

METHODOLOGY

We conducted a retrospective observational analytical study over a period of 24 months, from January 1, 2020 to December 31, 2021, in the anesthesia-resuscitation department of the CHU d'Angré. Were included without restriction of age, sex or immunological status all patients admitted for a clinical presentation suggesting meningoencephalitis, defined by the presence of a disorder of consciousness (Glasgow score 13), a meningeal syndrome (neck stiffness, signs of Brudzinski or Kernig), convulsions, and/or focal neurological signs, and having benefited from a lumbar puncture with CSF analysis.

The definition of meningoencephalitis used is based on the validated criteria of Venkatesan *et al*., (2013): acute onset, persistent deterioration of mental state for at least 24 hours, with at least two additional criteria among fever, focal neurological deficit, convulsions, pleiocytosis, abnormalities in the imaging or electroencephalogram, after exclusion of a non-infectious cause [1]. CSF analyses followed standardized thresholds: pleiocytosis > 5 cells/mm 3, lymphocytosis > 70% in case of clear liquid, glycorachie/glycemic ratio between 0.5 and 0.66, and proteininorachie > 0.45 g/L [6].

Patients admitted outside the study period, those who had undergone a recent neurosurgical intervention (less than six months) or with a recent known neurological pathology were excluded to avoid diagnostic and prognostic biases related to other etiologies. The clinical, biological and evolutionary data were extracted in a standardized way from the medical records using a dedicated sheet. The clinical outcome was evaluated according to a binary criterion: favorable in case of clinical improvement leading to the exit or transfer, or biological normalisation of the CSF when available; unfavorable in case of death during the stay. The data was entered and analyzed with the software Epi InfoTM 7.2. The quantitative variables were described by mean, median and standard deviation, while the qualitative variables were in numbers and percentages. For the identification of prognostic factors, a univariate analysis was carried out using the exact Fisher test, with a significance threshold set at $p < 0.05$. Due to the limited sample size, multivariate analyses were not performed. The limitations related to the retrospective nature of the study, the lack of systematic access to multiplex PCR or advanced molecular techniques for etiological confirmation, as well as the possible heterogeneity of management, were taken into account in the interpretation of the results.

RESULTS

Out of a total of 744 patients admitted to intensive care during the study period, 30 had meningocephalitis, corresponding to a frequency of 4.03%. The average age of the patients was 24.3 20.5 years, with extremes ranging from 25 days to 77 years. The age group 0-5 years was the most represented (33.3%). Men accounted for 53.3% of the population studied. The main reason for admission was the occurrence of disorders of consciousness associated with convulsions. Respiratory distress was observed in 46.7% of cases. More than half of the patients (53.3%) came from pediatric emergency rooms. The most common comorbidities were diabetes and arterial hypertension, each found in 27.3% of cases.

In 66.7% of the cases, clinical signs had appeared less than eight days before admission. Asthenia was reported in 40% of patients. At admission, hyperthermia was observed in 73.3% of cases, and headaches in 53.3%. Meningeal irritation was present in 23.3% of cases. Coma was common, with a Glasgow score between 6 and 7 in 50% of cases (see **Table I)**. Convulsions concerned 80% of patients, mostly of the generalized tonic-clonic type (79.2% of the seizures observed). Rhinorrhoea was noted in 38.9% of cases and sinusitis in 22.2%. Among the sixteen patients with respiratory signs, signs of struggle were systematically observed (100%), followed by a cough in 87.5% of cases. Normal oxygen saturation was found in 53.3% of patients. Loss of appetite and vomiting were almost constant. Of the 30 cases, a lumbar puncture was performed in 19 patients (63.3%), with cerebrospinal fluid (CSF) analysis. The macroscopic aspect of CSF was clear in 78.9% of cases (see **Table II).**

Significant leucocytorachias (> 5 elements/mm 3) were found in 42.1% of cases, while 57.9% had a leucocytorachias below this threshold. A lymphocyte predominance (> 70%) was observed in 73.7% of the samples. Hyperproteinorachy was present in 68.4% of cases, and the glycorachial/blood sugar ratio was normal in 52.6% of cases. The microbiological analyses (direct examination, soluble antigens, culture and PCR) did not identify any germ in the CSF. Five patients (16.7%) had malaria, and blood culture was positive in 10% of cases, with isolation of Staphylococcus aureus and Escherichia parcel. Blood leukocytosis was found in 53.3% of cases. Five patients (16.7%) were HIV positive. Procalcitonin exceeded 1 µg/L in 46.7% of cases. Hyponatremia was observed in 43.3% of cases. No diagnosis of certainty could be established for all cases. However, 13 patients (43.3%) were classified as having probable infectious meningoencephalitis, followed by five cases of neuropaludism, four cases of probable acute bacterial meningitis and three cases of probable cerebral toxoplasmosis in HIV field (see **Figure 1)**. A septic state and an HIV infection were each associated with meningoencephalitis in 16.7% of cases. Hydrocephalus was identified in 3.3% of cases.

The trend was unfavourable in 70.0% of cases, with a particularly high mortality rate. The univariate analysis by the Fisher test showed no statistically significant association between the occurrence of death and age, Glasgow score, presence of neurological deficit, haemoglobin level, thick-drop result or HIV status (**see Table III).**

Table I: Distribution of patients by general, neurological and ENT signs

Signs		Number (N=30)	Proportion (%)
Generals	Asthenia	12	40
	Emaciation	11	36,7
	Anorexia	10	33,3
Neurological	Meningeal irritation	7	23,3
	Headaches + ocular revulsion	6	20
	Headaches + amnioscopy	5	16,7
	Sensory deficit	5	16,7
	Motor deficit	5	16,7
	Headaches + Babinski sign	4	13,3
	Urinary incontinence	4	13,3
	Disorders of consciousness	4	13,3
	Adynamia	3	10
ORL	Rhinorrhoea	7	38,9
	Sinusite	4	22,2
	Tinnitus	3	16,7
	Tonsillitis	2	11,1
	Odynophagie	2	11,1

Table II: CRL Review

Parameters		Staff	Proportion (%)
Macroscopic aspect of the CSF	Clear	15	78,9
	Trouble	2	10,5
	Xanthochromic or bloody	2	10,5
Cytological formula	Lymphocytes	14	73,7
	Monocytes	3	15,8
	Neutrophils	2	10,5
Proteinorachie (g/l)	High school	13	68,4
	Normale	6	31,6

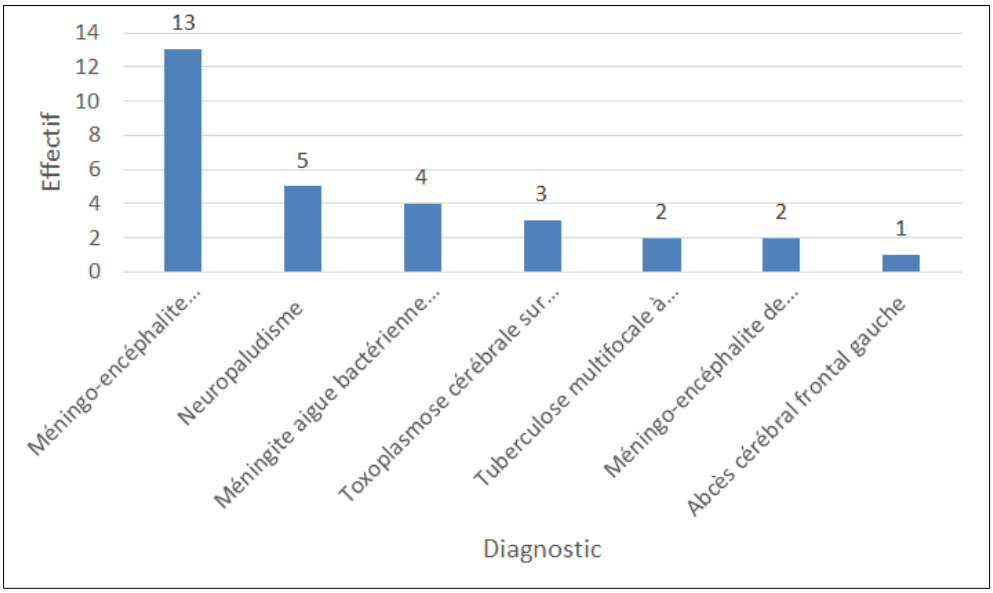

Figure 1: Distribution of patients according to the selected diagnosis

Table III: Correlation between age, Glasgow score, deficit, Hemoglobin rate, Thick Gout, HIV and the occurrence of death

Deaths	Alive		Deaths		Total	p
Variables	n	%	n	%		
Age > 60 years	0	0	3	100	3	0,534
Glasgow score 8	3	21,4	11	78,6	14	1
Motor deficit	0	0	4	100	4	0,555
Hemoglobin 9	3	25	9	75	12	0,645
GE positive	2	40	3	60	5	0,27
HIV	0	0	3	100	3	1

DISCUSSION

This retrospective study conducted at the University Hospital of Angré provides valuable insights into the clinical, biological and evolutionary profile of ED patients admitted to multipurpose intensive care in an African context with limited resources. Our cohort is characterized by a particularly young population, with a median age of 13 years and one third of patients aged 0 to 5 years, marked contrast with the European series where the incidence of EM increases with age in relation to demographic ageing and the predominance of autoimmune causes in adults [7, 8]. In sub-Saharan Africa, this pediatric predominance is notably explained by the high prevalence of neuro-meningeal infections such as cerebral malaria and bacterial meningitis, as well as a still high infant mortality, modifying the age structure of the affected population [9].

The frequent delay in admission (symptoms present for 7 days in more than two-thirds of cases) reflects the difficulties in quickly accessing specialized care due to geographical, financial and organizational constraints. These delays contribute to the high initial clinical severity, marked by a deep coma, generalized convulsions in 80% of cases, and respiratory distress in almost half of admissions.

The observed clinical manifestations, including fever, disturbances of consciousness and convulsions, are in accordance with Venkatesan criteria and compatible with international series [1-11]. Associated signs, such as rhinorrhea (38.9%), sinusitis (22.2%) or respiratory and digestive symptoms, direct towards specific etiologies involving notably Influenza A, adenovirus, Mycoplasma pneumoniae, Mycobacterium tuberculosis, or enterovirus according to the tables presented [12].

The non-negligible frequency of co-infections and comorbidities complicates management. HIV infection (16.7%) and sepsis (16.7%) reflect an immunocompromised context favoring the emergence of opportunistic agents such as toxoplasmosis, cryptococcosis or cerebral tuberculosis, while reducing therapeutic efficacy. Moreover, arterial hypertension and diabetes, found in 27.3% of cases each, can worsen brain damage and negatively affect the prognosis [13].

Lumbar puncture was performed in 63.3% of cases. This moderate rate reflects both organizational constraints (reluctance to an invasive procedure, clinical instability of patients, medical contraindications) and technical limitations. The CSF was predominantly clear, with a moderate lymphocyte-predominant pleiocytosis, high proteinuria and hypoglycorrachy in one quarter of cases, indicating an active neuroinfectious inflammatory process.

However, no pathogen could be identified by direct examination, antigen, culture or PCR. This finding is consistent with the data from the California Encephalitis Project where 62% of encephalitis remained without a determined etiology [3]. Three main reasons can explain this situation: frequent prior antibiotic therapy reducing the sensitivity of cultures [4], the lack of access to advanced molecular techniques such as multiplex PCR or metagenomics, now recommended for indeterminate encephalitis [2-12], and the possibility of non-infectious etiologies or rare/emerging agents outside the conventional diagnostic panel [1, 2].

These diagnostic limitations highlight the imperative need to invest in rapid and sensitive tools to improve etiological diagnosis, particularly in resource-limited settings.

The clinical course was unfavorable in 70% of cases, with a mortality rate much higher than that of countries with high resources (generally 10–20% for herpes encephalitis and up to 40–70% in the most severe forms in intensive care) [6]. In Africa, several studies report mortalities between 25 and 40%, confirming a significant disparity related to diagnostic delays, comorbidities, and lack of access to advanced techniques [4, 5].

In our cohort, the lack of statistically significant association between mortality and classical factors such as age, GCS score, neurological deficit or HIV status is probably due to the limited sample size. Nevertheless, these data highlight the urgency to strengthen local capacities through the implementation of standardized protocols, the expansion of access to diagnostic molecular biology as well as the reduction of delays between the onset of symptoms and the initiation of treatment.

These measures are likely to substantially improve survival and reduce the neurological sequelae associated with meningoencephalitis in our sub-Saharan context.

CONCLUSION

This retrospective study at the CHU of Angré reveals a significant severity of EM in intensive care, mainly affecting a young population with a strong pediatric predominance. The mortality rate reaches 70%, significantly higher than the data for countries with high resources and even in several African contexts.

The lack of microbiological identification of pathogens in the cerebrospinal fluid highlights the diagnostic limits related to prior antibiotic therapy and the lack of access to modern molecular methods (multiplex PCR, metagenomics).

No classical prognostic factors were significantly associated with death, probably due to the small sample size and the complexity of the prognosis.

These results call for strengthening diagnostic and therapeutic capacities, standardizing care, and improving the coordination of care. Furthermore, the management of post-resuscitation neurological sequelae must be integrated to reduce long-term morbidity.

Declaration of Conflict of Interest: We note that there is no conflict of interest on the source of funding or on the affiliation of the author.

Distribution of Tasks

Each author contributed in the following sections:

Koffi Loes, Ahouangansi Sêtondji Emmanuel Raymond: research work design, critical reading and final version approval.

N'Cho Arthur Nicaise, Goré YvesLandry, Achio Donald, Kouadio François: data collection and analysis, bibliographic research and writing.

Ayé Yikpé Denis, N'Guessan Yapi Francis: critical reading and approval of the final version.

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Cite This Article : Koffi Loes, Ahouangansi SER, Ayé YD, N'Cho AN, MYC Kouakou, Goré YL, Achio D, Kouadio F, N'Guessan YF (2025). Meningoencephalitis in Intensive Care in a Context with Limited Resources: Diagnostic Issues, and Therapeutic Challenges. *EAS J Anesthesiol Crit Care, 7*(4), 75-79.