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Case Study

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ANAEROBIC BACTERIAL MENINGITIS COMPLICATING INTRACRANIAL EMPYEMA IN AN IMMUNOCOMPROMISED PATIENT

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ABSTRACT

A 45-year-old man with recently diagnosed human immunodeficiency virus (HIV) infection, not yet receiving antiretroviral therapy, presented with pansinusitis complicated by an orbital abscess requiring surgical drainage. The clinical course was marked by the subsequent development of an intracranial empyema, confirmed by imaging and managed by craniotomy with evacuation of the purulent collection. Cerebrospinal fluid analysis revealed a clear bacterial meningitis profile, with marked leukocytosis predominantly composed of neutrophils. Direct examination following Gram staining demonstrated encapsulated Gram-negative bacilli, strongly suggestive of anaerobic bacteria of the genus *Bacteroides*. However, cultures, including those performed under anaerobic conditions, as well as multiplex meningitis/encephalitis PCR, remained negative. This discordant profile highlights the diagnostic limitations of conventional microbiological techniques in anaerobic infections, particularly due to their high sensitivity to oxygen and the critical impact of pre-analytical conditions. In addition, commonly used syndromic molecular panels do not target these organisms, potentially leading to underestimation of their role. Species of the genus *Bacteroides*, which are commensals of the oro-sinus flora, play a major role in polymicrobial intracranial infections of ENT origin. Their virulence is largely related to their polysaccharide capsule, which promotes abscess formation and immune evasion. This case therefore illustrates the fundamental value of direct microscopic examination in early diagnostic orientation, as well as the need for integrated interpretation of clinical and microbiological data, particularly in immunocompromised patients.

KEYWORDS:

- Bacteroides
- Anaerobic bacteria
- Bacterial meningitis
- Intracranial empyema
- Immunocompromised

CASE REPORT

A 45-year-old man with recently diagnosed HIV infection who had not initiated antiretroviral therapy, with a history of untreated hypertension, chronic tobacco use, and alcohol consumption, was initially admitted for pansinusitis complicated by an orbital abscess. Surgical drainage was performed. During hospitalization, the patient experienced a seizure, prompting brain imaging that revealed an intracranial empyema requiring craniotomy and evacuation of the purulent collection.

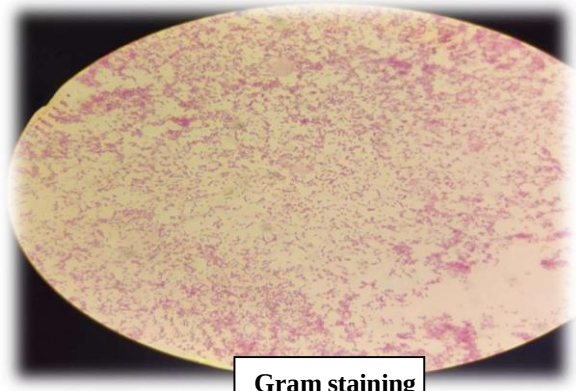
A postoperative lumbar puncture suggested meningeal involvement. Empirical broad-spectrum antibiotic therapy was initiated, resulting in transient clinical improvement.

One month later, the patient was readmitted with rapidly worsening neurological status. On admission, he presented with coma (Glasgow Coma Scale score of 7), fever (39°C), neck stiffness, respiratory distress with severe hypoxemia, tachycardia, and hypertension.

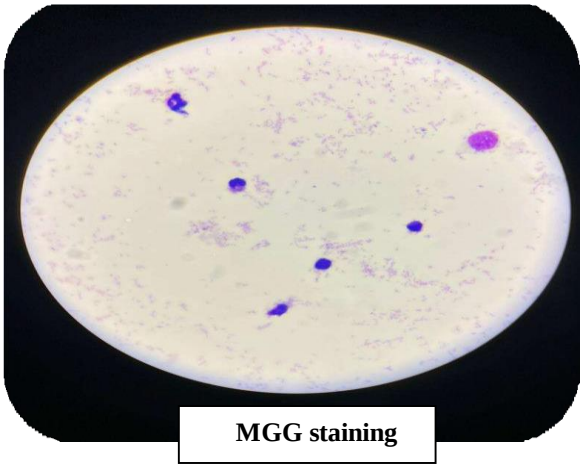
Brain computed tomography demonstrated persistence of a left frontal collection with mass effect and suspected ventricular extension.

Thoracic imaging revealed right-sided infectious pneumonia. Laboratory findings showed a marked inflammatory syndrome and acute renal failure.

Cerebrospinal fluid (CSF) appeared turbid on macroscopic examination. Cytological analysis revealed 20,000 leukocytes/mm³ with 97% neutrophils, consistent with bacterial meningitis. Gram staining demonstrated abundant small encapsulated Gram-negative bacilli morphologically compatible with anaerobic Bacteroides species. Multiplex meningitis/encephalitis PCR was negative.



Gram staining



MGG staining

Both aerobic and anaerobic cultures remained negative; notably, anaerobic culture was performed approximately one hour after sampling, a delay that may have compromised bacterial viability.

Despite treatment with metronidazole, trimethoprim-sulfamethoxazole and amikacin, the clinical course was unfavourable, progressing to severe sepsis with multiorgan failure and refractory septic shock, ultimately resulting in death.

DISCUSSION

Intracranial complications of sinus infections primarily result from locoregional spread to subdural or cerebral spaces.[1]

Despite advances in management, these infections remain associated with significant mortality and neurological sequelae, particularly when diagnosis or treatment is delayed.[2,3]

The pre-analytical phase in the investigation of anaerobic bacteria is critical to ensure reliable microbiological diagnosis, since these organisms are highly oxygen-sensitive and prolonged exposure can lead to false-negative results. The use of sterile equipment and airtight transport devices with appropriate transport media is essential. In addition, rapid specimen delivery under conditions that minimize contact with air and maintain a suitable temperature helps preserve bacterial viability and supports accurate interpretation of findings.[8,9]

Microbiologically, intracranial empyemas of ENT origin are typically polymicrobial and frequently involve anaerobic bacteria derived from the oro-sinus flora.[4,5]

Among these, Bacteroides species play a central role due to their capacity to cause deep, encapsulated Accurate microbiological diagnosis of anaerobic infections requires strict pre-analytical conditions. Because these organisms are highly sensitive to oxygen, any delay in transport or prolonged air exposure may compromise viability and result in false-negative cultures.[8,9]

In our case, the interval between sample collection and anaerobic culture likely contributed to the absence of bacterial isolation despite a contributive direct examination.

Furthermore, syndromic molecular panels used in emergency settings, such as multiplex meningitis/encephalitis assays, target a limited range of common pathogens and do not include anaerobic bacteria such as Bacteroides spp.[10]

Therefore, a negative PCR result does not exclude anaerobic etiology and must be interpreted cautiously considering clinical and radiological findings.

Finally, HIV-related immunosuppression represents an aggravating factor, potentially modifying clinical presentation, accelerating disease progression, and increasing the severity of central nervous system infections.[11]

This underscores the importance of an integrated diagnostic approach combining clinical, radiological, and microbiological data.

Our case emphasizes a key message: in intracranial complications of sinus origin, negative cultures and molecular tests should not rule out anaerobic infection. Direct microscopic examination remains a fundamental diagnostic tool and should be interpreted within a comprehensive clinic-biological context.

CONCLUSION

This case highlights the diagnostic challenges associated with anaerobic bacteria, particularly species of the genus Bacteroides, whose identification may be compromised by their high sensitivity to oxygen, the critical impact of pre-analytical conditions, and their absence from targeted molecular panels. The negativity of both cultures and molecular techniques, despite highly suggestive cytological and microscopic findings, underscores the limitations of current diagnostic tools in this context.

It also emphasizes the fundamental importance of direct microscopic examination in early diagnostic orientation, especially in severe central nervous system infections. The combination of conventional microbiological methods, based on rigorous sampling and transport conditions, with advanced identification techniques appears essential to improve the detection of anaerobic pathogens and to optimize therapeutic management, particularly in immunocompromised patients.

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