

Ruptured intraventricular brain abscesses due to *Fusobacterium nucleatum* with obstructive hydrocephalus: illustrative case

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BACKGROUND *Fusobacterium* spp. are strictly anaerobic microorganisms and normal flora of the oropharyngeal, gastrointestinal, and female genital tracts. It is commonly associated with periodontal disease, pharyngitis, mastoiditis, and tonsillitis, with a tendency to abscess formation.

OBSERVATIONS The authors report a case of brain abscesses complicated by ventriculitis and obstructive hydrocephalus caused by *Fusobacterium nucleatum* of suspected odontogenic source. While repeated bacterial cultures remained negative, the isolate was identified using bacterial sequencing.

LESSONS Empirical antimicrobial coverage for *F. nucleatum* should be considered in patients presenting with brain abscess. Genetic bacterial sequencing utilizing 16S ribosomal RNA molecular diagnostic testing may assist in microorganism identification to guide antimicrobial therapy.

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KEYWORDS brain abscess; *Fusobacterium nucleatum*; ventriculitis

Fusobacterium spp. are strictly anaerobic gram-negative microorganisms commonly found in the upper respiratory, gastrointestinal, and urogenital tract.¹ *Fusobacterium nucleatum* is the most isolated species, frequently in association with periodontal disease and abscesses.² Intracranial abscesses caused by *F. nucleatum* are rarely reported, likely because of the anaerobic nature of *F. nucleatum*, complicating its isolation and identification.³ Here, we report a rare case of culture-negative brain abscesses due to *F. nucleatum* complicated by ventriculitis and acute obstructive hydrocephalus in an immunocompetent individual.

Illustrative Case

A 59-year-old White male presented with lethargy and progressive weakness that had started 4 days prior to admission, accompanied by nausea, vomiting, and severe headache. Physical examination was normal, with a Glasgow Coma Scale score of 15. Medical history was remarkable for chronic obstructive pulmonary disease, atrial fibrillation,

hypertension, type 2 diabetes mellitus (DM), heavy cigarette smoking, and moderate alcohol consumption.

Initial head computed tomography (CT) revealed bilateral frontal lobe and left occipital lobe lesions with mild vasogenic edema and increased density of the cerebrospinal fluid (CSF) within the left lateral ventricle concerning for ventriculitis (Fig. 1). Magnetic resonance imaging (MRI) of the brain redemonstrated these multiple abscesses, leptomeningeal disease, and extension of the infection into the left lateral, third, and fourth ventricles with early progressive hydrocephalus compared with the CT scan (Fig. 2). A chest CT performed to rule out underlying malignancy was remarkable for a solid nodule to the right upper lobe lung area (Fig. 3). The patient became progressively more lethargic, prompting admission to the intensive care unit (ICU) with urgent placement of an external ventricular drain (EVD) in the right frontal horn. CSF was obtained and antimicrobial therapy with cefepime and vancomycin initiated. CSF was identified as cloudy with leukocytes at 4420/μL (neutrophils,

ABBREVIATIONS CSF = cerebrospinal fluid; CT = computed tomography; DM = diabetes mellitus; EVD = external ventricular drain; ICU = intensive care unit; MRI = magnetic resonance imaging; PCR = polymerase chain reaction; rRNA = ribosomal RNA; VPS = ventriculoperitoneal shunt.

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FIG. 1. Brain CT demonstrating severe obstructive hydrocephalus secondary to ventriculitis with increasing intraventricular pus.

94%; lymphocytes, 2%; monocytes, 4%), red blood cells at 184/ μ L, glucose at 69 mg/dL, and protein at 94 mg/dL. CSF, blood, and respiratory cultures were all negative. CSF cytology was negative for a malignant process and CSF pathology only confirmed suppurative diagnosis. The patient was transferred to the Houston Methodist main hospital

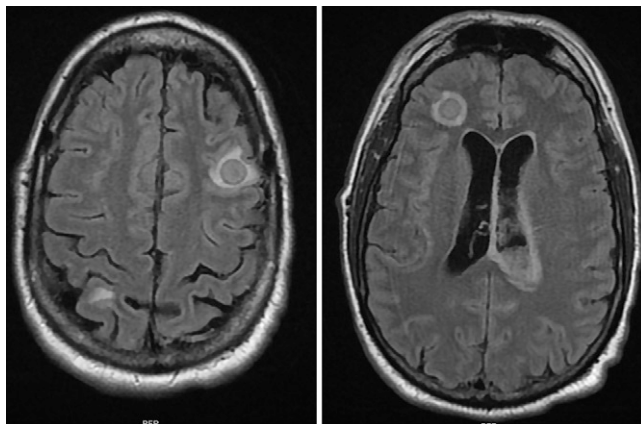


FIG. 2. Brain MRI showing multiple abscesses in the frontal lobe, right parietal lobe, and left occipital lobe and the spread of infection into the ventricular system with obstructive hydrocephalus secondary to ventriculitis. PFR = perifornical region slice.

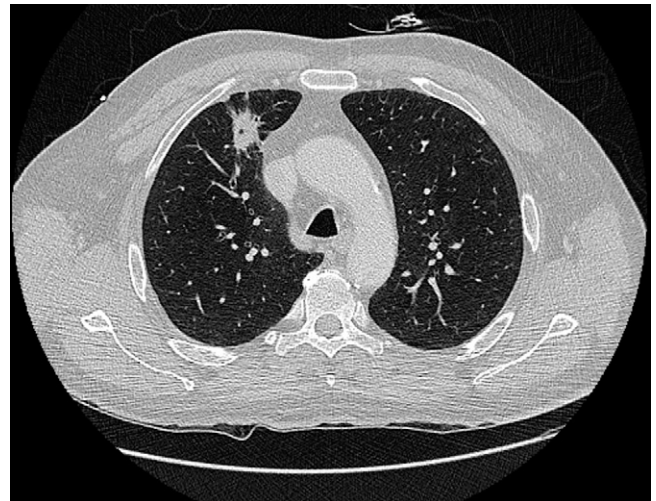


FIG. 3. Chest CT showing a solid nodule to the right upper lobe lung area.

neurosurgical ICU for higher level of care. Antimicrobial coverage was broadened to linezolid, meropenem, and intrathecal vancomycin and gentamicin. Repeat head CT revealed progressive pus in the left lateral ventricle with obstructive hydrocephalus, necessitating endoscopic third ventriculostomy and placement of a second right frontal EVD. The patient's neurological symptoms gradually improved.

With the absence of a culprit microorganism and chest imaging revealing cavitary lesion, bronchoscopy was performed. Bronchial alveolar lavage cultures grew *Candida lusitanae* and *Aspergillus fumigatus*. As a result, the antimicrobial regimen was changed to voriconazole, ceftriaxone, and metronidazole. With negative CSF 1,3-beta-D-glucan and galactomannan results and brain MRI showing lesion reduction, fungal CSF infection was unlikely. Repeated CSF Gram staining and cultures remained negative; therefore, a brain biopsy was conducted. The biopsy was notable for intracerebral pockets of purulent discharge. Brain biopsy tissue and CSF were sent for bacterial sequencing using 16S ribosomal RNA (rRNA) polymerase chain reaction (PCR), which detected the presence of *F. nucleatum*. Antimicrobial therapy was changed to ampicillin/sulbactam. Meanwhile, the patient continued to experience obstructive hydrocephalus requiring placement of a right and left ventriculoperitoneal shunt (VPS). After VPS placement, the patient's mentation improved and he was able to be discharged home with outpatient physical therapy 1 month later to complete 6 weeks of ampicillin/sulbactam therapy. At the 3-month follow-up visit, the patient had no residual neurological deficits, fever, or headache. His examination was normal with stable head imaging and without fluid collection. His Montreal Cognitive Assessment (MoCA) score at his 9-month visit was 22/30, consistent with mild cognitive impairment.

Discussion

Observations

This is, to our knowledge, the first case of brain abscesses due to *F. nucleatum* complicated by ventriculitis and obstructive hydrocephalus requiring VPS placement. While 12 cases of adults with fusobacterial brain abscesses have been reported in the literature, only 1 case presented with ventriculitis, without hydrocephalus, and

with a complete response to antibiotic therapy alone.^{4,5} In our case, the development of ventriculitis with obstructive hydrocephalus is likely related to the leakage of adjacent cerebral abscesses into the ventricles.

This case highlights the importance of bacterial molecular diagnosis as a more sensitive method for anaerobic bacteria identification compared with anaerobic CSF bacterial culturing. The isolate in our case did not grow using the traditional bacterial culturing methods and necessitated bacterial sequencing for identification. *F. nucleatum* is strictly anaerobic, which makes pathogen isolation a complicated and sensitive process with a high failure rate.⁶ In fact, only 8 out of 12 cases of fusobacterial brain abscesses were recovered from cultures.⁴ In contrast to bacterial culture, bacterial sequencing is able to identify a bacterial infection even with very low colony-forming units. The universal gene utilized for bacterial sequencing is the 16S rRNA gene, which is highly conserved in all bacteria. This gene contains signature sequences unique to many major groups of prokaryotic organisms. Organisms are identified to a genus and species level, by aligning 2 PCR-aligned regions of DNA sequence across the 16S rRNA gene against a publicly available reference database, with complete agreement of the alignment required for definitive identification.

Our case also shows that such infections, while more common in association with otitis media or sinusitis in pediatrics and a history of neurosurgery in adults, can occur in adult patients with no significant predisposing infection. In our case, the patient had an uneventful dental implantation 6 months prior to presentation. The latter, in addition to smoking and a history of DM, is a factor that predisposed our patient to a higher level of *F. nucleatum*.⁶⁻⁸

Lessons

In conclusion, *F. nucleatum* infections should be considered in patients with brain abscess. While this microorganism would typically be covered by an empirical antimicrobial regimen for brain abscess, genetic bacterial sequencing utilizing 16S rRNA molecular diagnostic testing might be of special utility in cases that remain culture negative to obtain diagnosis and provide adequate antimicrobial therapy treatment.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Srour, Demand, Zhang, Lista, Lin. Acquisition of data: Srour, Demand, Zhang. Analysis and interpretation of data: Srour, Demand, Zhang, Musick, Lin. Drafting of the manuscript: Srour, Demand. Critically revising the article: Demand, Zhang, Musick, Lista, Lin. Reviewed submitted version of the manuscript: all authors. Administrative/technical/material support: Lista. Study supervision: Musick, Lista.

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