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Single vs multiple pathogens in brain abscesses: two cases with distinct aetiologies

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ABSTRACT

Brain abscesses represent life-threatening focal infections with diverse aetiologies. In the current era of escalating antimicrobial resistance, medical management is increasingly challenged and empiric regimens may be insufficient. We report two young immunocompetent male patients with brain abscesses due to distinct aetiologies: a monomicrobial subdural and epidural collection caused by Streptococcus constellatus and a polymicrobial post-traumatic orbitofrontal abscess associated with Enterococcus faecalis and Escherichia coli. Both patients underwent urgent surgical drainage combined with broad-spectrum intravenous antibiotics, later tailored to culture results. The first case illustrates the risk of suboptimal oral therapy and poor adherence, with subsequent relapse and development of antimicrobial resistance, whereas the second case highlights infectious complications following penetrating orbito-cranial trauma. These contrasting cases emphasise the need for timely neurosurgical intervention, prolonged targeted antimicrobial therapy, and strict avoidance of unsupervised antibiotic use in the management of brain abscesses.

Keywords
brain abcess, subdural empyema, epidural abcess, polimicrobial infection, streptococcus constellatus, antibiotic resistance

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1. INTRODUCTION

A brain abscess is defined as a localized accumulation of pus within the brain parenchyma or meninges, enclosed by a distinct capsule. This pathology typically arises as a secondary complication stemming from adjacent infections or from systemic sources. [1] Brain abscesses account for a small proportion of intracranial space-occupying lesions, but they carry substantial morbidity and mortality, especially when diagnosis or treatment is delayed. Most cases arise by contiguous spread from otitis, mastoiditis, or sinusitis, or via hematogenous dissemination from distant infective foci such as endocarditis or lung abscesses. Penetrating head trauma and neurosurgical procedures represent less frequent but clinically important causes, often associated with polymicrobial infections and more resistant organisms. [2] In contemporary series, brain abscess accounts for approximately 1–2% of intracranial space-occupying

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lesions, with reported mortality rates of about 5–15% despite advances in imaging and antimicrobial therapy.

Microbiological patterns typically differ according to the route of infection. Contiguous and odontogenic abscesses usually involve streptococci of the Streptococcus anginosus group, anaerobes, and mixed oral flora, whereas hematogenous abscesses tend to be monomicrobial. Post-traumatic and post-neurosurgical abscesses are more often polymicrobial and may include staphylococci, enterococci, and aerobic Gram-negative bacilli. [3]

In this context, we present two contrasting cases: a large epidural and subdural collection due to a single Streptococcus constellatus strain and a post-traumatic orbitofrontal abscess associated with multiple pathogens. By comparing their clinical course and management, we aim to highlight the practical implications of single versus polymicrobial infection for neurosurgeons. [4]

2. Methods

We conducted a descriptive retrospective case report including two male patients diagnosed with intracranial abscess/empyema and treated in the Neurosurgery Department of Sibiu County Emergency Hospital. Clinical data, imaging findings, operative notes, microbiological results and follow-up information were obtained from institutional medical records. Microbiological diagnosis was established by culture of material collected intraoperatively from the abscess cavity and/or associated soft-tissue collections. Demographic characteristics, presumed source of infection, anatomical location, number and type of pathogens, surgical procedures, antimicrobial regimens and clinical outcomes were extracted and are summarised in Table 1. Written informed consent was obtained from both patients for publication of this case report and the accompanying images.

3. Case 1

A 21-year-old male presented to our emergency department with a severe headache with onset approximately 3 weeks prior and a left-sided motor deficit. The patient was conscious but uncooperative and confused, with a Glasgow Coma Scale (GCS) score of 14.

A multidetector computed tomography (MDCT) scan was performed, revealing a right frontal subdural fluid collection, a thin right parasagittal subdural fluid layer, and an extensive anterior high-frontal and left parasagittal fluid collection. Additionally, spontaneous hyperdensity of the falx cerebri and tentorium, marked diffuse cerebral edema of the right hemisphere, and fluid-density accumulation occupying the paranasal sinuses were observed. (Figure A)

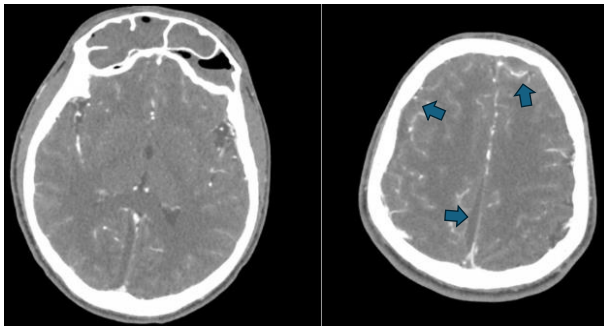

Figure A. Initial MDCT scans showing right frontal and parasagittal subdural collections with significant right hemispheric edema

Based on imaging investigations and patient history, the diagnosis of left frontal epidural abscess, and right parasagittal and fronto-temporo-parietal (FTP) subdural empyema was established.

A right FTP decompressive craniotomy was performed, with lavage and drainage of the right frontal and left parasagittal subdural empyema, and of the left epidural abscess.

The following day, a reintervention was performed, consisting of the enlargement of the decompressive craniectomy to allow expansion of the edematous brain.

Microbiological analysis revealed the presence of *Streptococcus constellatus*, susceptible to the majority of antibiotics. Intravenous empirical therapy with a third-generation cephalosporin plus metronidazole was initiated and later tailored to the susceptibility profile of S. constellatus. The patient remained hospitalised, with serial CT/MRI showing progressive reduction of the collections and mass effect.

The patient was discharged with instructions to avoid physical exertion, exposure to cold and damp environments, and local trauma. The prescribed home treatment regimen included antibiotics, antiepileptics, analgesics, antipyretics, and vitamins.

Despite medical advice, the patient continued unsupervised oral levofloxacin (750 mg/day) for several months after discharge. At

readmission, cultures from the recurrent abscess demonstrated a markedly reduced susceptibility profile, with sensitivity retained only to teicoplanin. This evolution suggests that prolonged, suboptimal oral therapy and poor adherence may have contributed to the selection of a resistant S. constellatus strain.

Over the following months, the patient was readmitted twice. The first readmission, prompted by complaints of headache, involved the evacuation of the right occipital abscess contents and excision of the capsule (Figure B). The second admission was for cranioplasty (Figure C)

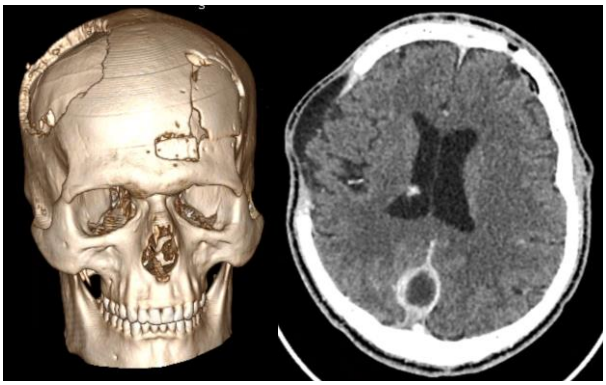

Figure B. Left: Postoperative imaging appearance; Right: Well-encapsulated occipital interhemispheric abscess identified after 1 month of antimicrobial therapy.

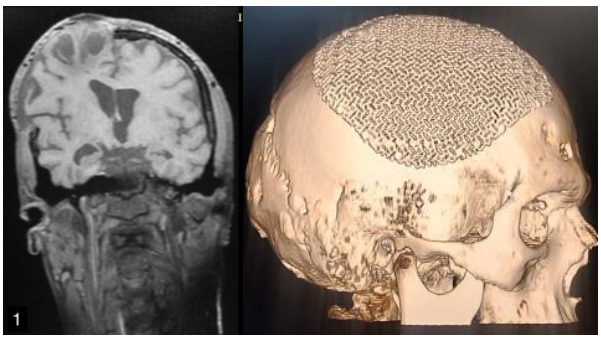

Figure C. 1 – Brain MRI revealing fungus cerebri (transcalvarial herniation of the cerebral parenchyma) through the craniectomy defect. 2 – CT scan status post right frontoparietal cranioplasty (6 months later).

At 6-month follow-up, he remained seizure-free under levetiracetam, with mild residual left-sided weakness and no radiological evidence of recurrent infection.

4. Case 2

We present the case of a 33-year-old male admitted for a right upper eyelid abscess three days following a penetrating cranio-facial trauma with a metallic object. CT imaging revealed a complex orbital fracture, pneumocephalus, and an intraparenchymal bone fragment (Figure C), which were initially managed conservatively. However, despite the resolution of the local infection, the patient developed delayed post-traumatic seizures, necessitating urgent transfer to the Neurosurgery department for the management of the penetrating orbito-cranial injury. He had no history of immunosuppression or major chronic disease.

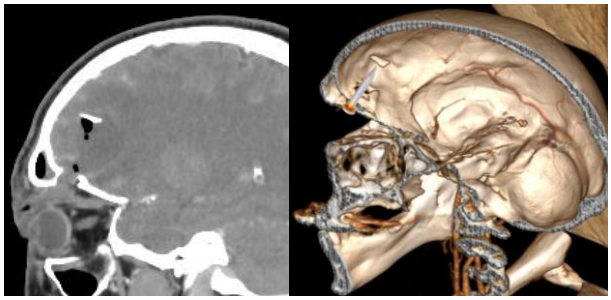

Figure D. Left – Cranial CT scan demonstrating a comminuted and displaced fracture of the right orbital roof. Associated findings include a small right frontal intraparenchymal pneumocephalus and limited subarachnoid hemorrhage. Right – 3D reconstruction demonstrating the trajectory of the metallic object and the migrated bone fragment secondary to the fracture.

The patient received an initial antibiotic regimen consisting of Ceftriaxone, Vancomycin, and Metronidazole. However, due to the lack of clinical improvement and the onset of an epileptic seizure 4 days after starting antibiotic treatment, the decision was made to proceed with neurosurgical intervention.

Repeat CT revealed an enlarging right frontal ring-enhancing lesion with surrounding edema and mass effect, despite 4 days of antibiotic therapy. Given the lesion size (>2 cm) and the new-onset seizures, surgical evacuation was indicated.

Neurosurgical intervention was performed under general anaesthesia, consisting of a right frontal craniotomy with evacuation of the right frontal abscess and removal of the intraparenchymal bone fragment.

Bacteriological examination isolated *Enterococcus faecalis* from the cerebral abscess and *Escherichia coli*

from the eyelid abscess. Both pathogens were found to be susceptible to antibiotics.

Based on susceptibility testing, ceftriaxone was de-escalated and the regimen was switched to high-dose ampicillin plus gentamicin to provide synergistic bactericidal activity against E. faecalis, while anaerobic coverage was maintained with metronidazole. The E. coli isolate from the eyelid abscess was fully susceptible to third-generation cephalosporins and fluoroquinolones and did not produce extended-spectrum β-lactamases.

At the time of discharge, the patient was conscious, cooperative, and temporo-spatially oriented. He was in good general condition, remained seizure-free, and showed complete resolution of neurological symptoms. A home treatment regimen consisting of antibiotics, anticonvulsant therapy, and corticosteroids for cerebral edema management was prescribed.

At 12-month follow-up, the patient had no recurrent seizures under anticonvulsant prophylaxis and CT showed complete resolution of the lesion.

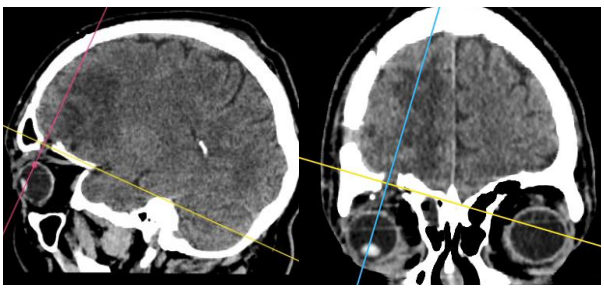

Figure E. Postoperative CT demonstrating regression of cerebral edema and reduction of the abscess cavity.

5. Discussion:

Streptococcus constellatus is a gram-positive, catalase-negative, facultatively anaerobic coccus that typically arranges in chains. The organism is characterized by its propensity to cause purulent infections and abscesses, a trait that distinguishes it from many other viridans streptococci. [2] In the Streptococcus family, antibiotics penetrate abscesses poorly and bacteria exposed to sub-inhibitory concentrations may develop mutations in penicillin-binding proteins (PBPs). These mutations alter the antibiotic target site, preventing penicillin from binding effectively. [3],[4]

Escherichia coli (E. coli) is a gram-negative, rod-shaped bacterium. It is the most dominant facultative anaerobe in the non-pathogenic human intestinal flora. [5] Resistance is primarily mediated by the secretion of beta-lactamases, which destroy the antibiotic molecule prior to its action. Isolates producing Extended-Spectrum Beta-Lactamases (ESBLs) are capable of degrading cephalosporins, whereas carbapenemase-producing stains inactivate carbapenems. [6][7]

Enterococcus faecalis is a gram-positive facultatively anaerobic coccus. While it morphologically resembles streptococci, it is distinguished by its extreme environmental durability. [8] E. faecalis exhibits intrinsic resistance to cephalosporins. It possesses specific proteins (PBP4 and PBP5) that have a very low affinity for these antibiotics, allowing the bacterium to synthesize its cell wall even in their presence. [9]

In our first patient, the infection was caused by a single S. constellatus strain, likely originating from paranasal sinus disease, as suggested by the CT findings. This pattern is consistent with previous reports, in which S. anginosus group streptococci are frequently isolated from brain abscesses arising from sinusitis, otitis, or odontogenic infections. By contrast, post-traumatic abscesses and post-neurosurgical infections are more often polymicrobial and may involve environmental Gram-negative bacilli, staphylococci, and enterococci.

The second case reflects this pattern: the penetrating orbitofrontal injury led to a polymicrobial infection involving E. faecalis and E. coli. Polymicrobial abscesses are associated with a higher risk of antimicrobial resistance and typically require broader empiric coverage, often combining a third-generation cephalosporin with metronidazole and, in selected settings, vancomycin or a carbapenem until culture results are available.

Penetrating orbito-cranial injuries are uncommon but carry a high risk of intracranial infection, particularly when associated with retained foreign bodies and contamination by skin, sinus, or environmental flora. Small orbital wounds may initially appear benign and the intracranial trajectory can be easily overlooked, leading to delayed diagnosis of cranial injuries and brain abscesses.

Awareness of these mechanisms is crucial, as early imaging and prophylactic broad-spectrum antibiotics may reduce the risk of severe infectious complications.

Antibiotic resistance is escalating. The contributing factors are multifactorial,

encompassing the use of antibiotics in the agro-industry, non-adherence to treatment regimens and self-medication, with the latter being the most prevalent. [10][11]

Current guidelines emphasise that successful treatment of brain abscess almost always requires a combination of surgical drainage and prolonged high-dose antimicrobial therapy. Empiric treatment is guided by the presumed source and is later narrowed based on cultures, with a recommended total duration of 6–8 weeks of intravenous therapy, followed by careful imaging and clinical follow-up. The need for repeated aspirations or craniotomy is dictated by lesion size, location, mass effect, and response to therapy; abscesses larger than 2–2.5 cm or those causing significant mass effect are usually managed surgically. [12]

Both of our patients required surgical evacuation due to mass effect and neurological symptoms. In the first case, early decompressive craniectomy was necessary to control malignant cerebral edema, while in the second case craniotomy allowed removal of both the abscess and the intraparenchymal bone fragment along the transorbital trajectory. [13]

The clinical course of the first patient illustrates the dangers of unsupervised oral antibiotic use in the setting of intracranial infection. Prolonged home-based levofloxacin therapy, outside of specialist supervision and without appropriate intravenous induction, may have contributed to selection of a less susceptible S. constellatus strain and delayed definitive management. This observation aligns with broader data showing that self-medication, poor adherence, and inappropriate antibiotic choice are major drivers of antimicrobial resistance at the population level.

Prognosis in brain abscess depends on multiple factors, including preoperative neurological status, level of consciousness, presence of multiple lesions, intraventricular rupture, and comorbidities such as immunosuppression. Both of our patients were young and immunocompetent, presented with relatively preserved GCS scores, and received timely neurosurgical and antimicrobial treatment, which likely contributed to their favourable functional outcomes despite the severity of their intracranial infections.

Limitations

A limitation of this report is the small number of patients and the absence of systematic reporting of laboratory parameters and long-term neurocognitive outcomes. Nevertheless, the contrasting aetiologies and microbiological patterns provide useful illustrative scenarios for everyday neurosurgical practice.

6. Conclusion:

These cases highlight the central role of neurosurgical drainage combined with prolonged, carefully supervised antimicrobial therapy in the management of brain abscesses with different etiologies. While the first patient presented with an extensive monomicrobial collection due to S. constellatus, the second developed a polymicrobial post-traumatic abscess involving E. faecalis and E. coli. In both scenarios, timely surgical intervention, culture-guided antibiotic therapy, and close radiological follow-up were essential for a favourable outcome. The relapse and resistance pattern observed in the first case further underline the risks of unsupervised, prolonged oral antibiotic use in such severe infections and reinforce the need for strict antibiotic stewardship and patient education.

From a practical perspective, these cases suggest that monomicrobial abscesses arising from contiguous sinus disease and polymicrobial post-traumatic orbitofrontal abscesses may differ in their microbiological spectrum and empiric coverage requirements, but they share a common need for timely neurosurgical drainage and prolonged, supervised antimicrobial therapy.

Table 1. Key differences between the two brain abscess cases.

Parameter	Case 1 – Non-traumatic empyema (single pathogen)	Case 2 – Penetrating orbitofrontal abscess (multiple pathogens)
Patient / etiology	21-year-old male; likely contiguous spread from sinus infection	33-year-old male; penetrating trans-orbital trauma with metallic object
Location / imaging	Left frontal epidural + right parasagittal/FTP subdural empyema; marked right hemispheric edema	Right orbitofrontal intraparenchymal abscess near orbital roof fracture; limited SAH/pneumocephalus

Parameter	Case 1 – Non-traumatic empyema (single pathogen)	Case 2 – Penetrating orbitofrontal abscess (multiple pathogens)
Microbiology	**Single pathogen:** *Streptococcus constellatus*	**Polymicrobial:** *Enterococcus faecalis* (brain) + *Escherichia coli* (eyelid)
Main treatment	FTP decompressive craniotomy with drainage; later occipital abscess evacuation and cranioplasty; IV antibiotics + prolonged unsupervised oral levofloxacin at home	Right frontal craniotomy, abscess evacuation and bone fragment removal; IV ceftriaxone + vancomycin + metronidazole, then targeted therapy
Complications	Fungus cerebri, recurrent abscess; selection of fluoroquinolone-resistant *S. constellatus*	Early post-traumatic seizures; no documented infectious recurrence
Outcome at discharge	Conscious, oriented, afebrile; improved motor status	Conscious, oriented, seizure-free on anticonvulsants; good general condition

References

1. Slazinski T. Brain abscess. Critical Care Nursing Clinics of North America. 2013 Sept;25(3):381–8. doi:10.1016/j.ccell.2013.04.001
2. Bilska-Stokłosa J, Tomczak H, Hampelska K, Smuszkiewicz P, Zawadzki T, Osmola K. Streptococcus constellatus as an aetiological factor of extensive neck phlegmon complicated by sepsis – case study. Annals of Agricultural and Environmental Medicine. 2019 Jun 17;26(2):252–5. doi:10.26444/aaem/93735
3. Hakenbeck R, Brückner R, Denapaite D, Maurer P. Molecular mechanisms of β-lactam resistance in streptococcus pneumoniae. Future Microbiology. 2012 Mar;7(3):395–410. doi:10.2217/fmb.12.2
4. Haenni M, Moreillon P. Mutations in penicillin-binding protein (PBP) genes and in non-PBP genes during selection of penicillin-resistant streptococcus gordonii. Antimicrobial Agents and Chemotherapy. 2006 Dec;50(12):4053–61. doi:10.1128/aac.00676-06
5. Naidoo N, Zishiri OT. Presence, pathogenicity, antibiotic resistance, and virulence factors of escherichia coli: A Review. Bacteria. 2025 Mar 11;4(1):16. doi:10.3390/bacteria4010016
6. Kerek Á, Román I, Szabó Á, Kovács D, Kardos G, Kovács L, et al. Antibiotic resistance genes in escherichia coli – literature review. Critical Reviews in Microbiology. 2025 Apr 18;1–35. doi:10.1080/1040841x.2025.2492156
7. C Reygaert W. An overview of the antimicrobial resistance mechanisms of bacteria. AIMS Microbiology. 2018;4(3):482–501. doi:10.3934/microbiol.2018.3.482
8. Van Tyne D, Martin M, Gilmore M. Structure, function, and biology of the Enterococcus faecalis cytolysin. Toxins. 2013 Apr 29;5(5):895–911. doi:10.3390/toxins5050895
9. Miller WR, Munita JM, Arias CA. Mechanisms of antibiotic resistance in enterococci. Expert Review of Anti-infective Therapy. 2014 Sept 9;12(10):1221–36. doi:10.1586/14787210.2014.956092
10. Wang T, Wu J, Li J, Zhou P, Li Q, Xu X, et al. Is self-medication with antibiotics among the public a global concern: A mixed-methods systematic review. Expert Review of Anti-infective Therapy. 2024 Oct 20;22(12):1199–208. doi:10.1080/14787210.2024.2419607
11. Rahman S, Hollis A. The effect of antibiotic usage on resistance in humans and food-producing animals: A longitudinal, one health analysis using European Data. Frontiers in Public Health. 2023 Jun 15;11. doi:10.3389/fpubh.2023.1170426
12. Cindea C, Saceleanu V, Tudor V, Canning P, Petrascu O, Kerekes T, Breazu A, Roman-Filip I, Roman-Filip C, Mihaila R. Prognostic Factors and Clinical Outcomes of Spontaneous Intracerebral Hemorrhage: Analysis of 601 Consecutive Patients from a Single Center (2017–2023). NeuroSci. 2025;6(3):77. doi:10.3390/neurosci6030077.
13. Breazu A, Cindea C-N, Lucaciu S, Iliescu A, Sasu S, Saceleanu V. Gemistocytic astrocytoma mimicking hypertensive haemorrhage: A rare case of tumour disguised as intracerebral haemorrhage. Romanian Neurosurgery. 2025;39(1):22–27. doi:10.33962/roneuro-2025-003.