

Post-traumatic Rhinogenic Subdural Empyema Complicated with Brain Abscess Caused by *Prevotella* Species: A Case Report of Dual-Drainage Strategy with Bone Flap Preservation

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Case Report

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Abstract

Background

Post-traumatic rhinogenic intracranial infections are rare but life-threatening complications. Concurrent subdural empyema and brain abscess present significant diagnostic and therapeutic challenges.

Case Presentation

: We report a 19-year-old male patient who developed right frontoparietal subdural empyema complicated with brain abscess following facial trauma and acute exacerbation of chronic sinusitis. The patient presented with fever and altered consciousness (GCS 10). MRI revealed multi-compartment intracranial abscesses and sinus involvement. Bacterial culture identified *Prevotella* species. Considering the multi-compartment distribution of infection and the specific risks of bone flap management in active infection, we adopted a bone flap-preserving “dual-drainage” strategy combining neurosurgical burr hole drainage with endoscopic sinus surgery. Postoperative treatment included continuous vancomycin irrigation through drainage catheters combined with intravenous meropenem. The patient showed progressive neurological improvement and was discharged with favorable functional outcome on postoperative day 13.

Conclusion

This case demonstrates that for multi-compartment post-traumatic rhinogenic intracranial infections, a bone flap-preserving “dual-drainage” minimally invasive strategy combined with multidisciplinary collaboration may be superior to conventional craniotomy.

1. Introduction

Intracranial infections, including brain abscess and subdural empyema, are serious and potentially life-threatening conditions in neurosurgery ^[1]. The routes of infection include direct spread from adjacent infected foci, hematogenous dissemination, and post-traumatic or post-surgical complications, with more than 50% of cases related to head and neck infections such as sinusitis ^[1].

Post-traumatic rhinogenic intracranial infection is a relatively rare but challenging emergency, typically spreading through anatomical defects such as frontal or ethmoid sinus fractures^[2]. These infections often involve both the subdural space and brain parenchyma, forming multi-compartment lesions that increase diagnostic and therapeutic complexity ^[3].

The choice of surgical approach for such complex infections remains controversial. Surgical treatment for brain abscess mainly includes craniotomy with excision and aspiration/drainage ^[4, 5]. Craniotomy

offers direct visualization for complete evacuation of purulent material and abscess

capsule, though aspiration is associated with a lower reoperation rate (20.7% vs. 39.4%) ,while aspiration/drainage is less invasive with shorter operative time ^[4, 5]. However, craniotomy also involves bone flap management, which presents additional risks and challenges in active infection, including bone flap osteomyelitis, intracranial pressure management, and implant-related infections ^[6, 7].

This case report describes a young male who developed right frontoparietal subdural empyema complicated with brain abscess following maxillofacial trauma and acute exacerbation of chronic sinusitis, successfully treated with a bone flap-preserving “dual-drainage” minimally invasive strategy.

2. Case Presentation

2.1 Patient Information

A 19-year-old male presented to the emergency department on March 15, 2026, with intermittent fever and altered consciousness. Three days prior, the patient fell from a bicycle sustaining minor maxillofacial contusion. The day after trauma, he developed intermittent high fever with peak temperature of 39°C. Past medical history included chronic sinusitis. Emergency otolaryngology consultation revealed purulent discharge in the right external auditory canal.

Vital signs on admission: temperature 36.8°C, heart rate 121 bpm, blood pressure 140/96 mmHg, GCS 10 (E2V2M6).

2.2 Laboratory Findings

Complete blood count: white blood cell count $16.61 \times 10^9/L$, neutrophil count $12.47 \times 10^9/L$, neutrophil percentage 75.1%. Inflammatory markers: C-reactive protein 203.61 mg/L, procalcitonin 0.153 ng/mL.

2.3 Imaging Studies

Preoperative brain MRI (March 15, 2026) demonstrated: crescent-shaped subdural collection along the right frontoparietotemporal convexity with T1 hypointensity and T2 hyperintensity, showing high signal on diffusion-weighted imaging. Patchy T2 hyperintensity in the right frontal lobe. Mucosal thickening in the right frontal, ethmoid, and maxillary sinuses with T2 hyperintense fluid collections. Post-contrast images showed linear enhancement along the subdural collection and gyral enhancement in the right frontal lobe (Fig. 1).

Impression: Right frontal lobe inflammatory lesion; right frontoparietal subdural empyema; sinusitis with intrasinus purulent collection.

2.4 Surgical Treatment

On March 17, 2026, the patient underwent combined surgical procedures under general anesthesia.

Neurosurgical procedure

Right frontoparietal subdural empyema burr hole drainage with catheter placement and brain abscess aspiration. Linear incisions were made in the right frontal and temporal regions. Burr holes were created, and the dura was coagulated and incised. Yellowish-white purulent fluid under pressure was drained, and specimens were sent for bacterial culture. A drainage catheter was placed in the temporal abscess cavity connected to vancomycin irrigation solution (vancomycin 500mg in normal saline 500ml). Another drainage catheter was placed in the frontal abscess cavity connected to a sterile drainage bag. Approximately 30ml of purulent fluid was drained (Fig. 2).

Otolaryngological procedure

Endoscopic right maxillary, frontal, and ethmoid sinusotomy with abscess drainage. The right uncinate process was resected, and the maxillary sinus ostium was enlarged. Copious yellowish-white purulent secretions were suctioned from the sinus cavities. The ethmoid sinuses and frontal recess were opened, and the frontal sinus ostium was enlarged. Purulent secretions were drained from the frontal sinus.

Intraoperative culture: *Prevotella* species, anaerobic culture positive.

2.5 Postoperative Treatment

Postoperative antibiotic regimen: Vancomycin continuous irrigation through drainage catheter (postoperative days 1–8); meropenem 2g every 8 hours intravenously (postoperative days 1–15); linezolid 600mg every 12 hours orally (postoperative days 8–15).

The temporal drainage catheter was removed on postoperative day 8, and the frontal drainage catheter on postoperative day 9.

2.6 Follow-up and Outcome

Postoperative MRI on day 4 (March 21): Post-surgical changes with slight increase in right frontal lesion size, likely representing postoperative inflammatory response or cavity effect; decrease in subdural collection.

Postoperative MRI on day 11 (March 28): Post-surgical changes with stable subdural collection showing near-complete resolution of subdural empyema (Fig. 3).

Neurological recovery: GCS 6T on postoperative day 1; GCS 11 on day 4; GCS 14 on day 7; GCS 15 on day 11. At discharge (postoperative day 13), the patient was alert with mildly dysarthric but intelligible speech, left limb strength 5-, right limb strength 5.

No surgical site bleeding, new intracranial infection, brain herniation, or seizures occurred during hospitalization.

3. Discussion

3.1 Pathophysiology of Post-traumatic Rhinogenic Intracranial Infection

This case clearly demonstrates the typical pathophysiological chain of post-traumatic rhinogenic intracranial infection. Following facial trauma, acute exacerbation of chronic sinusitis allowed pathogens to spread directly through damaged anatomical barriers into the intracranial compartment, resulting in concurrent subdural empyema and brain abscess [2, 3].

3.2 Clinical Significance of Prevotella Infection

Culture from intraoperative specimens identified Prevotella species, an anaerobic bacterium commonly associated with oral and sinus flora. Prevotella species are part of the normal oral flora and are frequently encountered in chronic sinusitis and odontogenic infections [8]. Their relatively rare documentation in intracranial infections may be attributed to low anaerobic culture positive rates [8, 9].

3.3 Surgical Approach Selection

The core clinical value of this case lies in the selection of surgical approach. For multi-compartment infections involving the subdural space, brain parenchyma, and sinuses, conventional craniotomy is not the optimal choice.

Theoretical advantages and limitations of craniotomy: Craniotomy allows complete lesion resection with higher reoperation rates (39.4% vs. 20.7% for aspiration) [4, 5]. However, in this case, several limitations existed: widespread distribution of infection not amenable to single approach; subdural empyema not suitable for excision; greater surgical trauma; delayed infection control [3, 10, 11].

Considerations for bone flap management strategy

Craniotomy involves bone flap management, which presents multiple challenges in active infection. Bone flap osteomyelitis is a serious complication following craniotomy [6, 7]. A 2023 French study of 144 cases of bone flap-related osteomyelitis demonstrated that 72.9% of patients ultimately required bone flap removal, with 26.1% treatment failure despite mean 12.7 weeks of antibiotic therapy [6]. Returning a large bone flap during the postoperative cerebral edema peak results in loss of cranial compensatory capacity and increased risk of intracranial pressure decompensation [7]. Titanium screws and plates used for fixation provide an ideal substrate for bacterial biofilm formation [6, 12].

Advantages of minimally invasive drainage strategy

Burr hole drainage is the standard treatment for subdural empyema [10, 11]. It is less invasive with shorter operative time (30–60 minutes vs 2–4 hours). Multiple catheter placement allows adequate drainage. Continuous vancomycin irrigation through drainage catheters achieves high local drug concentration. Burr hole drainage avoids large bone flap mobilization, significantly reducing bone flap osteomyelitis risk,

preserves intact calvarial intracranial pressure compensatory capacity, and avoids biofilm-related infection risks from implant materials.

Synergistic effect of “dual-drainage” strategy

This case employed a “dual-drainage” strategy combining neurosurgical burr hole drainage with endoscopic sinus surgery. Simultaneous treatment of multiple infection sites allowed one-stage management of intracranial abscess, subdural empyema, and sinus primary infection. Multidisciplinary collaboration achieved synergistic effects ^[3, 13]. The comparison of craniotomy and minimally invasive drainage strategy is summarized in Table 1 .

Table 1
Comparison of craniotomy and minimally invasive drainage strategy

Feature	Craniotomy	Minimally invasive drainage
Reoperation rate	39.4% ^[5]	20.7% ^[5]
Operative time	2–4 hours	30–60 minutes
Subdural empyema management	Not suitable for excision	Drainage preferred
Multi-compartment infection	Difficult with single approach	Multiple catheter placement
Bone flap osteomyelitis risk	High (72.9% require removal) ^[6]	Very low
Intracranial pressure compensation	Limited	Preserved intact calvarium
Implant materials	Requires screws/plates	Not required
Simultaneous sinus surgery	Not feasible	Feasible

3.4 Dissociation Between Imaging and Clinical Assessment

The co-occurrence of brain abscess and subdural empyema is uncommon, reported in only approximately 6% of patients with subdural empyema in large series ^[10]. In this case, despite progressive neurological improvement, brain abscess size initially increased on postoperative imaging. This phenomenon may be explained by postoperative inflammatory response, cavity effect, and timing of postoperative MRI ^[14, 15]. This emphasizes that clinical neurological improvement should be prioritized over isolated radiological findings when assessing treatment response ^[14, 15].

4. Conclusion

This case presents successful management of complex intracranial infection (subdural empyema with brain abscess) secondary to maxillofacial trauma and chronic sinusitis, using combined neurosurgical and otolaryngological “dual-drainage” surgery with bone flap preservation.

Clinical implications: High suspicion for rhinogenic intracranial infection is essential in patients with fever and altered consciousness following head and facial trauma. For multi-compartment infections, bone flap-preserving “dual-drainage” minimally invasive strategy with multidisciplinary collaboration may be superior to conventional craniotomy. Avoiding large bone flap mobilization and implant materials in active infection reduces osteomyelitis (72.9% require secondary removal) ^[6] and biofilm-related infection risks, preserving intact calvarial intracranial pressure compensatory capacity, consistent with the surgical principle of “infection control first, structural reconstruction second” ^[6, 7].

Declarations

Patient Consent Statement

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Ethics Approval

This case report was conducted in accordance with the Declaration of Helsinki. Ethics approval was obtained from the Ethics Committee of Shanxi Provincial People’s Hospital (Approval No: (2026) SXPH-ERC-No.335).

Competing Interests

The authors declare that they have no competing interests.

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Author Contribution

C. Niu drafted the manuscript; J. Ma, X. Zhang, and X. Wei were responsible for the discussion and execution of the patient’s surgical management; and X. Zan, Y. Yang, P. Zhang, H. Li, G. Li, P. Feng, and S.

Anlu oversaw imaging data extraction and literature retrieval. All authors reviewed the manuscript.

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Figures

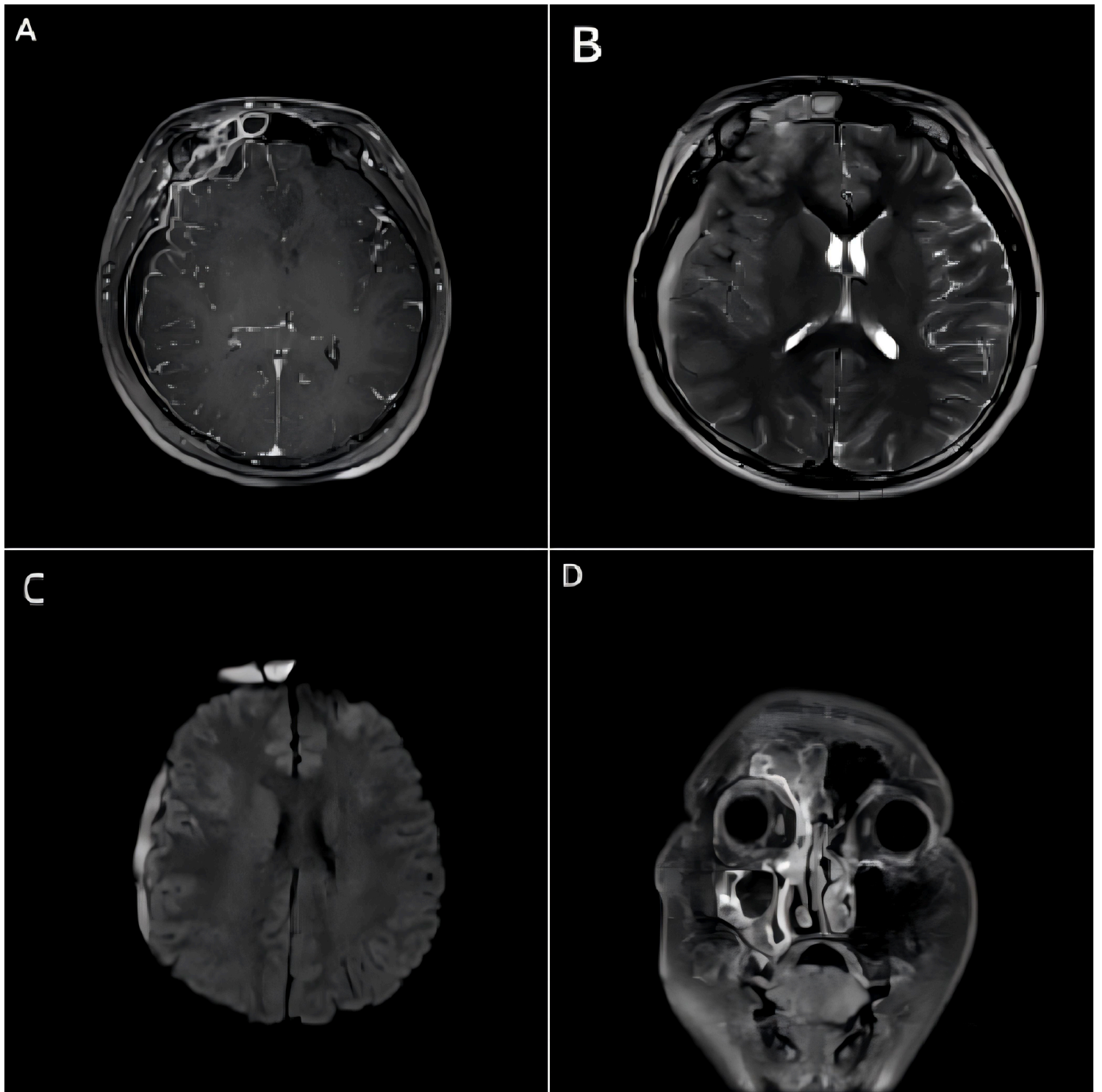


Figure 1

Preoperative brain MRI - (A) Axial T1-weighted post-contrast image showing ring-enhancing lesion in right frontal lobe (brain abscess) - (B) T2-weighted image showing hyperintense subdural collection along right frontoparietal convexity (subdural abscess) - (C) DWI showing marked hyperintensity in abscess center - (D) Coronal T1 post-contrast showing mucosal thickening and enhancement in right frontal, maxillary, and ethmoid sinuses

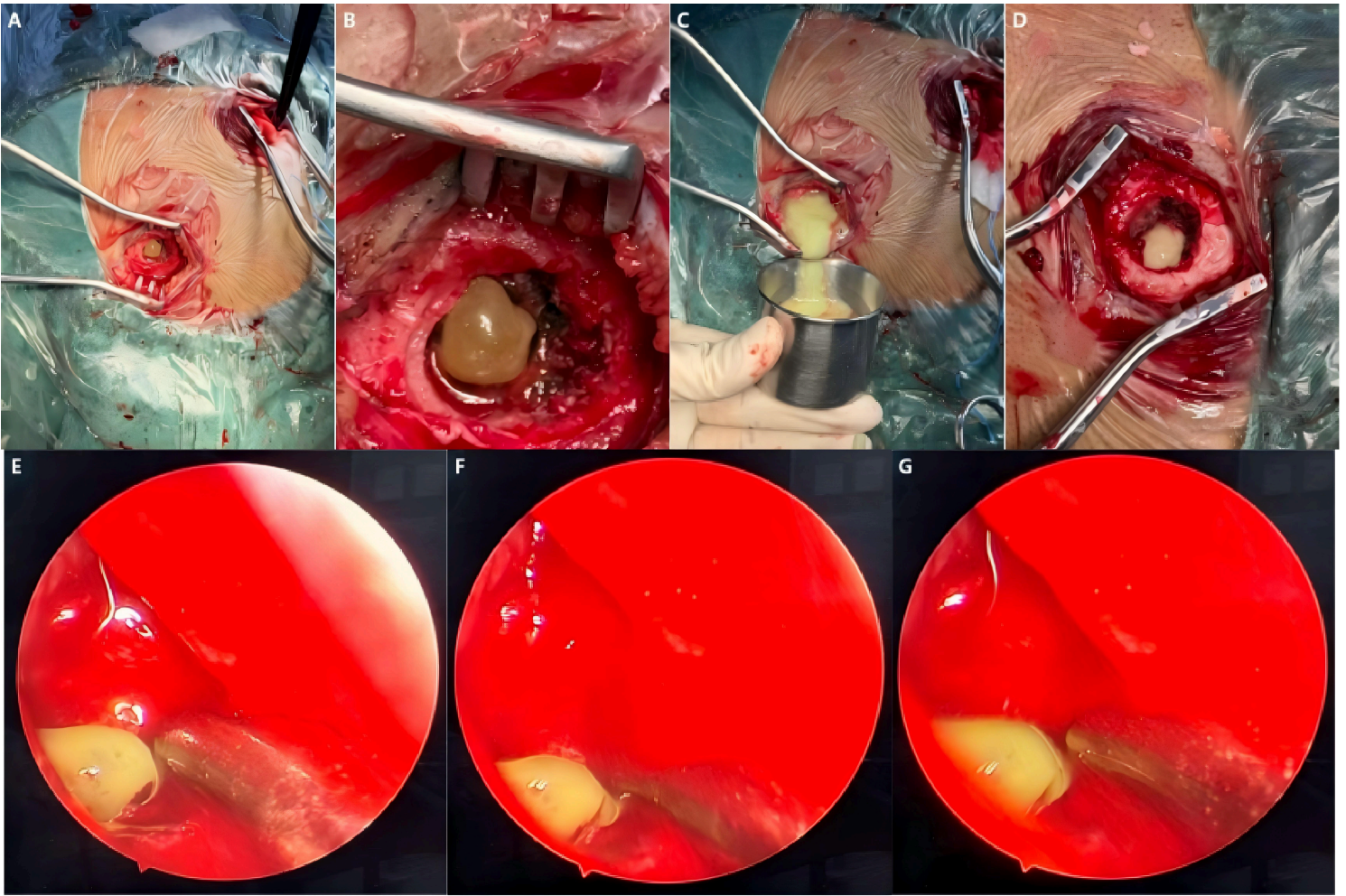


Figure 2

Intraoperative image - (A) temporal lobe and frontal lobe incision and drainage tube burial location - (B) intraoperative unruptured abscess - (C) abscess specimen removal after rupture - (D) abscess after rupture - (E) (F) (G) Obvious abscess visible in otolaryngological endoscopic surgery image

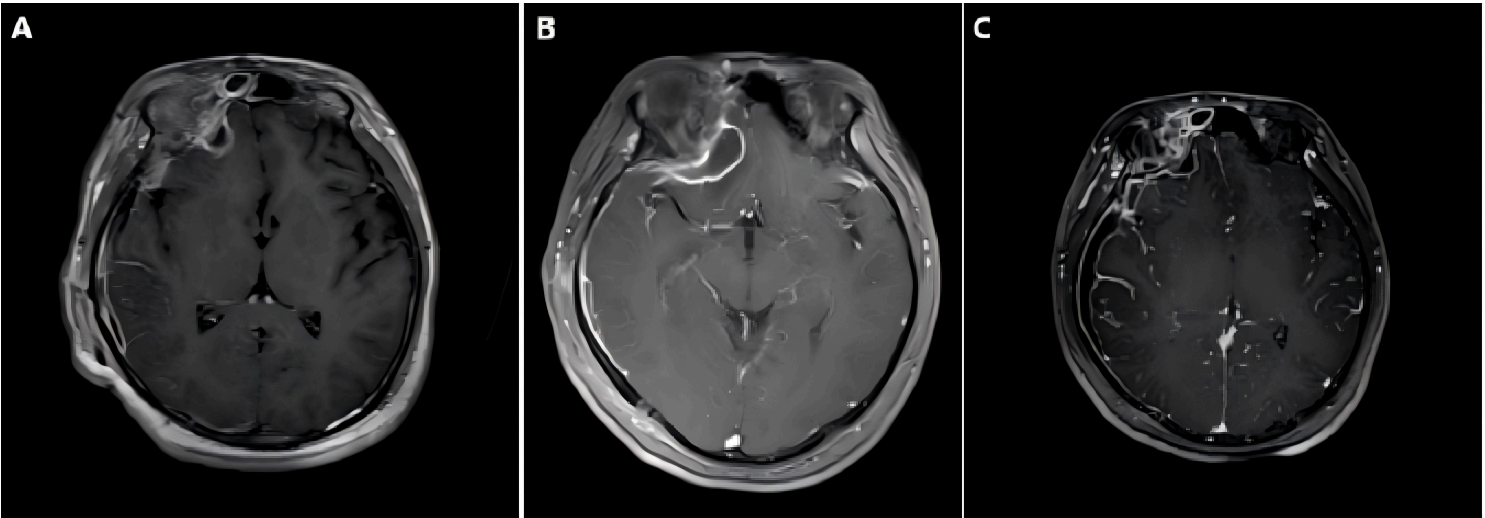


Figure 3

Postoperative MRI review contrast - (A) T1 enhancement showing reduction of subdural empyema on postoperative day 4 (March 21) - (B) T1 enhancement showing basic absorption of subdural empyema on postoperative day 11 (March 28) - (C) preoperative T1 enhancement showing subdural empyema