ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Professor of Clinical Neurosurgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Pediatric Neurosurgery

Editor
Frank Van Calenbergh, MD
University Hospitals; Leuven, Belgium

SNI
Open Access

Case Report

Drainage of middle cranial fossa epidural abscess through mastoidectomy: Our experience and review of the literature

Max Feng[1], Alexandra Vacaru[2], Vikrum Thimmappa[1], Brian Hanak[3]

[1]Department of Otolaryngology Head and Neck Surgery, Loma Linda University Health, [2]Loma Linda University School of Medicine, Loma Linda, [3]Department of Neurological Surgery, Childrens Hospital of Orange County, Orange, California, United States.

E-mail: *Max Feng - mfeng@llu.edu; Alexandra Vacaru - alexandravacaru@students.llu.edu; Vikrum Thimmappa - vathimmappa@llu.edu; Brian Hanak - b.w.hanak@gmail.com

***Corresponding author:**
Max Feng,
Department of Otolaryngology Head and Neck Surgery, Loma Linda University Health, Loma Linda, California, United States.

mfeng@llu.edu

Received: 09 August 2024
Accepted: 10 September 2024
Published: 25 October 2024

DOI
10.25259/SNI_674_2024

Quick Response Code:

ABSTRACT

Background: Otitis media (OM) can uncommonly lead to intracranial complications. Epidural abscesses represent a large proportion of cases; however, literature regarding the optimal surgical management of otogenic epidural abscesses is sparse. Favorably located epidural abscesses may be amenable to drainage through a transmastoid approach because the tegmen mastoideum lies immediately inferior to the middle cranial fossa (MCF).

Case Description: We report 3 pediatric patients with OM complicated by epidural abscesses of the MCF. The ages ranged from 3 to 6 years old, with 2 females and 1 male. All 3 patients had acute mastoiditis with an abscess of the MCF ranging from 1.6 cm to 6.3 cm at the largest dimension. All patients underwent canal wall-up mastoidectomy with the evacuation of the MCF abscess through a small window, 0.7 × 0.7 cm or less, created in the tegmen mastoideum. All patients were successfully treated through this approach and had complete resolution of their infection on follow-up imaging. There were no postoperative temporal lobe encephaloceles.

Conclusion: This is one of the few descriptions of the treatment of an otogenic epidural abscess of the MCF through a transmastoid approach. Collaboration with neurosurgery is vital because their familiarity with the intracranial space helped to guide the accurate direction of dissection. This highlights the importance of a multidisciplinary approach in the treatment of epidural intracranial abscess of the MCF through this approach. The risk of postoperative temporal lobe encephalocele was minimized due to the small tegmen defect size.

Keywords: Epidural abscess, Mastoidectomy, Middle cranial fossa, Otogenic abscess

INTRODUCTION

Otitis media (OM) can lead to both intratemporal and intracranial complications. Common intratemporal complications include mastoiditis, subperiosteal abscess, and facial nerve palsy.[4,9,11] Intracranial complications include epidural abscess, subdural abscess, brain abscess, dural sinus thrombosis, meningitis, petrous apicitis, and otic hydrocephalus.[5,8,9,12,15,16,18] Intracranial complications of OM can lead to significant mortality, with mortality rates ranging from 5% to 10% in the literature.[2,19] Intracranial complications arising from middle ear infections are exceedingly rare overall. Of 768 inpatient admissions for OM over 8 years at a single institution, intracranial complications were present in 40 (5.2%) cases.[8] They also make

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.
©2024 Published by Scientific Scholar on behalf of Surgical Neurology International

up a minority of overall complications of OM. In a review of 109 pediatric patients admitted for complications of OM over 15 years, intracranial complications represented 24.8% of cases.[11] *Streptococcus pneumoniae* is the predominant organism cultured in these cases.[1,4,8,11,22]

Within this subset of OM with intracranial complications, epidural abscesses represent a large proportion of cases. In a review of 33 patients with intracranial complications of OM over 8 years, 16 (48.5%) patients presented with epidural abscess. Literature regarding the optimal surgical management of otogenic epidural abscesses is sparse. The most common otologic surgical management involves canal wall up or canal wall down mastoidectomy with or without tympanostomy tube placement.[5,8,11,12,15,16] Canal wall-up mastoidectomy is performed in most cases. Canal wall down mastoidectomy, which involves drilling down the posterior external auditory canal wall, is reserved for cases in which extensive exposure to the middle ear space is required, such as in cholesteatoma. Neurosurgical collaboration remains a mainstay of therapy in the surgical treatment of this disease process, as epidural abscesses often require drainage through a burr-hole or craniotomy.[5-7]

Favorably located epidural abscesses may be amenable to drainage through a transmastoid approach, as the tegmen mastoideum lies immediately inferior to the middle cranial fossa (MCF). There are case reports of drainage of MCF, and posterior cranial fossa abscesses through violation of the tegmen mastoideum and the bony sigmoid plate during mastoidectomy, respectively.[14,20] Conservative management through intravenous antibiotics alone is also an option in small abscesses and if clinical symptoms and serial radiographs demonstrate improvement.[3,21]

We report three cases of pediatric OM complicated by MCF epidural abscesses. All three patients were successfully treated with the performance of a canal wall-up mastoidectomy with abscess evacuation through a small opening in the tegmen mastoideum.

CASE PRESENTATIONS

Patient 1

History and presentation

A 3-year-old male with a history of autism, cerebral palsy, and neonatal hemiplegic seizure due to left hemispheric stroke presented with complaints of worsening left otalgia, fever, and emesis. There was no associated otorrhea, tinnitus, hearing loss, disequilibrium, loss of consciousness, or seizures.

Clinical findings and diagnostic assessment

Computed tomography imaging of the temporal bone was performed, which showed acute left otomastoiditis with a 1.6 cm epidural abscess along the left MCF and a small subperiosteal/scalp abscess. Contrast-enhanced magnetic resonance imaging (MRI) showed a 1.6 × 0.9 cm rim-enhancing epidural fluid collection within the left posterior MCF, along with a 1.0 cm rim-enhancing fluid collection within the left postauricular soft tissues [Figure 1a].

Therapeutic intervention and outcome

The patient was started on ceftriaxone, vancomycin, and metronidazole. They underwent canal wall-up mastoidectomy and left tympanostomy tube placement. A postauricular Palva flap was raised. The subperiosteal abscess was drained. A canal wall-up mastoidectomy was then performed, and the antrum was widely opened. Next, with neurosurgical assistance, the tegmen mastoideum was progressively thinned down with a diamond burr until the temporal dura was exposed. A small tegmen window, measuring <0.7 × 0.7 cm, was created. Blunt dissection was carried out along the floor of the MCF with a freer elevator until purulence was encountered. After evacuation and irrigation of the abscess, a Penrose drain was placed in the mastoid cavity.

A repeat brain MRI obtained the day after surgery showed near-complete abscess evacuation [Figure 1b]. The patient completed a 5-day course of Ciprodex, along with 6 weeks of intravenous ceftriaxone and oral metronidazole without recurrence of infection.

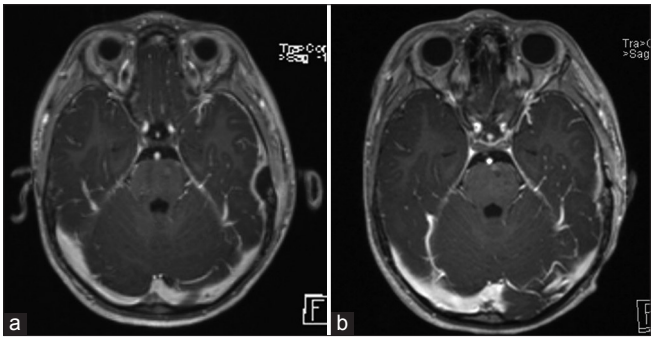

Figure 1: Left to right. (a) Axial T1+ magnetic resonance imaging (MRI) brain demonstrating a left middle cranial fossa epidural collection with associated regional dural enhancement. (b) Axial T1+ MRI brain on postoperative day 1 demonstrating resolution of left middle cranial fossa fluid collection with residual dural enhancement.

Patient 2

History and presentation

A 6-year-old female presented with fevers, ear pain, headaches, and altered mental status with cough and rhinorrhea for 6 days. She was seen at an outside clinic and prescribed Tamiflu, azithromycin, and amoxicillin. She had taken these medications for 2 days before presenting to our institution in the setting of progressive gait unsteadiness, mild confusion, emesis, diarrhea, right-sided neurologic deficits, and decreased interaction.

She was started on levetiracetam and fosphenytoin for possible seizures, as well as ceftriaxone, vancomycin, and acyclovir.

Clinical findings and diagnostic assessment

MRI Brain showed left mastoiditis with a left temporal epidural abscess measuring 4.0 × 1.6 × 3.7 cm, causing mass effect and vasogenic edema. Cerebritis of the adjacent left temporal lobe was also noted. Several smaller collections of fluid were also seen along the inferior temporal lobe and cerebellar hemisphere adjacent to the mastoid cavity [Figure 2a].

Therapeutic intervention and outcome

The patient underwent drainage of epidural abscess, canal wall-up mastoidectomy, and tympanostomy tube placement. A canal wall-up mastoidectomy was performed, and the antrum was widely opened. Significant granulation tissue was encountered and removed. The anterior tegmen was unroofed and widened using a curette, resulting in the discharge of a small amount of thin, purulent fluid. The neurosurgical team then bluntly explored the MCF anteriorly through the tegmen window using a number 4 Penfield. The space was irrigated with vancomycin irrigation until no purulence returned. Surgicel and a non-sutured Duragen patch were placed in the defect. Myringotomy was subsequently performed. Significant thick purulence was suctioned, and the middle ear was irrigated with vancomycin irrigation. A tympanostomy tube was placed, and ciprodex was instilled into the middle ear.

Repeat MRI on postoperative day 2 showed an interval decrease in the size of the epidural abscess to 0.8 cm [Figure 2b]. MRI brain also demonstrated a new intraparenchymal abscess that had formed in the previously noted zone of temporal lobe cerebritis. No additional surgery was recommended for this because most intraparenchymal abscesses resolve with antibiotic therapy alone, so long as the longest axis of the abscess is <3 Cm. The patient was discharged on an extended course of IV ceftriaxone and oral metronidazole. Repeat MRI at 6 weeks postoperatively demonstrated complete resolution of infection [Figure 2c].

Patient 3

History and presentation

A 3-year-old female with a history of anemia, obesity, and development delay.

She presented with right-sided facial swelling, right-ear drainage, and fever after a head injury 2 days prior and an ear infection 1-month prior that was previously treated with a 10-day course of amoxicillin.

Clinical findings and diagnostic assessment

During the initial physical examination, the patient was noted to have swelling on the right side of the face and drainage and tenderness at the right ear. MRI brain with contrast showed right OM with mastoiditis, right osteomyelitis, a small subperiosteal abscess, and an epidural abscess measuring up to 6.3 cm, occupying the middle and posterior cranial fossae [Figure 3a].

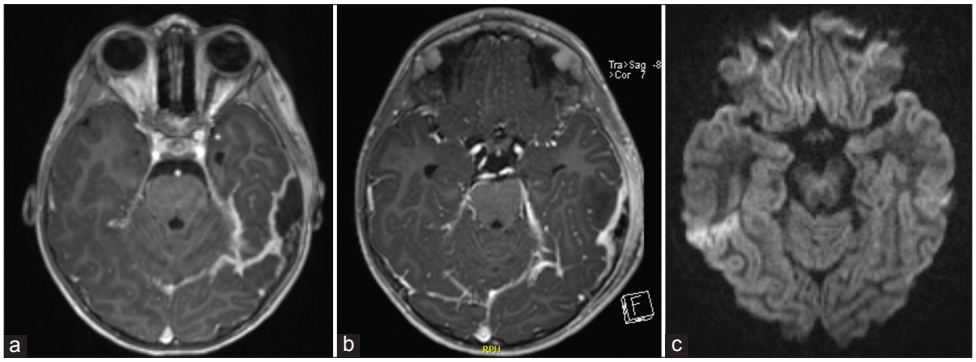

Figure 2: Left to right. (a) Axial T1+ magnetic resonance imaging (MRI) brain demonstrating a large left epidural abscess within the middle cranial fossa. (b) Axial T1+ MRI brain on postoperative day 2 showing near-complete resolution of the left middle cranial fossa epidural fluid collection. (c) Axial diffusion-weighted imaging at 6 week postoperatively demonstrating an absence of fluid restriction at the site of the previously seen epidural fluid collection.

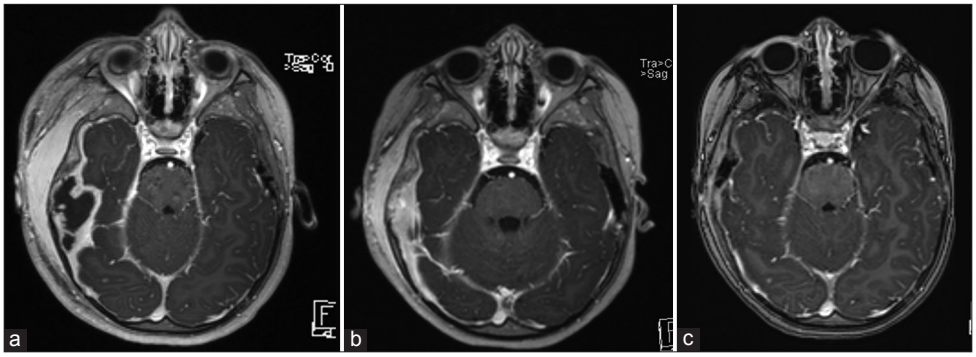

Figure 3: Left to right. (a) Axial T1+ magnetic resonance imaging (MRI) brain demonstrating a right epidural abscess within the middle cranial fossa. (b) Axial T1+ MRI brain on postoperative day 5 showing complete evacuation of the epidural fluid collection with expected persistent regional dural enhancement. (c) Axial T1+ MRI brain obtained 9 weeks postoperatively showed near-complete resolution of the previously seen dural enhancement and no evidence of epidural fluid collection.

Therapeutic intervention and outcome

The patient underwent canal wall-up mastoidectomy, tympanostomy tube placement, incision and drainage of subperiosteal abscess, and drainage of epidural abscess. A tympanostomy tube was first placed, with the middle ear purulent effusion evacuated. A canal wall-up mastoidectomy was performed, and the antrum was widely opened. Significant granulation tissue was removed during the mastoidectomy. A bony dehiscence was present over the right sigmoid sinus with purulence draining from the area. The opening was enlarged using a size 3 diamond burr to enhance access into the posterior fossa epidural fluid collection. The posterior fossa was then irrigated with saline. The tegmen mastoideum was thinned with a diamond burr to expose the dura. This tegmen defect was subsequently widened to slightly <0.7 × 0.7 cm in diameter. Blunt dissection was carried out in all directions toward the petrous ridge and lateral squamous temporal bone. Significant purulent material was evacuated. The middle fossa was then irrigated with saline. A quarter-inch Penrose drain was placed in the mastoid cavity.

Postoperative MRI showed decreased mass effect upon the right temporal lobe with overlying scalp cellulitis/myositis and residual small subperiosteal/scalp fluid collection [Figure 3b]. She was discharged on a 6-week course of ceftriaxone. On follow-up MRI 9 weeks postoperatively, there was no residual disease remaining, and the patient had complete resolution of infection [Figure 3c].

DISCUSSION

Intracranial infections encompass a rare but challenging complication of OM. In a review of 33 patients with intracranial complications secondary to OM, the most common complications were epidural abscess (30.3%) and sigmoid sinus thrombosis (27.3%).[11] In a similar review of otogenic intracranial complications, intracranial abscess encompassed 75% of complications, followed by lateral sinus thrombosis (40%), meningitis (27.5%), and otic hydrocephalus (10%). Interestingly, meningitis is a relatively rare complication of OM, with some authors speculating the widespread vaccination against *Haemophilus influenzae* has contributed to the significant decrease in the incidence of meningitis in children. This is further reinforced by reports demonstrating *S. pneumoniae* as the most common organism isolated in this disease.[3,4,11,23] There is evidence of increasing antibiotic resistance patterns of *S. pneumoniae* in the United States, which could lead to a greater risk of developing more advanced disease.[22] Other organisms isolated include *Proteus mirabilis, Pseudomonas aeruginosa, Streptococcus aureus,* and coagulase-negative Staphylococcus. The mean age of patients with advanced complications of OM trends toward younger patients, with one study reporting a mean age of 6 years, with a range of 8 months–14 years.[8] Younger age, as well as daycare attendance and antibiotic exposure, are known risk factors for the development of pneumococcal disease.[1] There is a predilection toward male patients.[22] Common symptoms include fever and otalgia. Other symptoms include headache, otorrhea, postauricular swelling, nausea, vomiting, and mental status changes.[8,9] Previously reported mortality rates of intracranial complications of OM ranged from 10% to 19%.[3] However, the mortality rate has declined in recent decades, with contemporary literature reporting a mortality rate of 5–10%.[2,19] This decline in mortality rate is likely due to advances in imaging leading to earlier detection and treatment of intracranial infections, as mortality rates increase with delays in diagnosis.[2]

The most common location of abscess formation was the epidural space. A large portion of epidural abscesses develop adjacent to the sigmoid sinus. In one study, the majority of epidural abscesses, 13 of 16 (81.2%), developed adjacent

to the sigmoid sinus, followed by the MCF.[8] Treatment of intracranial abscesses frequently requires surgical intervention, as intravenous antibiotics alone are usually not sufficient for clearance of infection. Ninety percent of patients in a series of pediatric patients with intracranial abscesses underwent surgery.[8] Otolaryngology intervention for epidural abscesses commonly involves cortical mastoidectomy with or without tympanostomy tube placement. In the same study, 15 of 16 patients underwent mastoidectomy with tympanostomy tube placement alone, with one patient undergoing craniotomy in addition to mastoidectomy, although the size and extent of the abscess, and need for additional surgical intervention was not specified. There is currently a paucity in the literature regarding when neurosurgical intervention is also indicated for otogenic intracranial abscesses. In a small case series of 8 patients with epidural abscess from sinusitis, 4 of the patients were treated successfully with craniotomy or burr hole, and the remaining 4 patients were successfully treated with intravenous antibiotics alone.[6] The authors in both studies mentioned above advocated for prompt surgical intervention in patients with sepsis, altered mental status, seizures, or neurologic deficits.

There are scattered case reports in the literature regarding transtemporal drainage of MCF and posterior cranial fossa epidural abscesses, as opposed to the standard craniotomy or burr-hole approach. One case report described drainage of a posterior fossa abscess by drilling the posterosuperior portion of the tegmen mastoideum and entering the abscess cavity through the defect. The final size of the defect was 0.5 cm^2. A residual cerebellar abscess was drained during the 3rd week through a craniotomy.[20] Similarly, a case report details the drainage of a posterior fossa epidural abscess by removing the sigmoid plate.[14] A larger study from a center in India reported on their experience with 61 patients, ages 3–65, with otogenic intracranial infections. 29 (48%) epidural abscesses were included. Their general technique involved performing a canal-wall up mastoidectomy for non-cholesteatoma (59%) and a canal-wall down mastoidectomy for cholesteatoma (41%) cases. In all cases, the mastoid disease was in continuity with the intracranial disease. In each case, either the tegmen, posterior fossa, or sigmoid sinus bony plate was thinned, and the abscess capsule was opened and drained. In 10 patients, an endoscope was used to inspect the abscess cavity for residual disease. Any dural defects created were repaired with a muscle graft and temporalis fascia or fascia lata. Tragal cartilage was used for the closure of the tegmen defect. The authors suggest a role for intravenous antibiotics alone for intracranial abscesses <1 cm in diameter.[13]

Our study is among the few to report a transmastoid approach to drainage of an otogenic epidural abscess in discontinuity with the mastoid cavity. Each presentation arose as a sequela of advanced OM and mastoiditis. In each of our cases, the patients were young, with ages ranging from 3 to 6 years old. The size of each abscess was over 1 cm, located within the epidural space of the MCF. A canal-wall up mastoidectomy was performed, and a standard antrostomy was performed to establish communication between the mastoid cavity and the middle ear. As the lateral aspect MCF directly overlies the tegmen mastoideum, the bony plate was thinned using a coarse diamond drill burr or curette, and the middle fossa dura was encountered. In each case, the size of the tegmen defect did not exceed 0.7 × 0.7 cm. From the tegmen approach, the abscess pocket could be reached with blunt dissection. The neurosurgical team was present intraoperatively to provide assistance or to perform the dissection. We chose not to close the tegmen defect so as to allow for continued drainage of the middle fossa into the mastoid cavity. Each patient also completed a 6-week course of intravenous antibiotic therapy. All three cases were treated successfully with a single-stage approach without the need for further drainage or evidence of recurrent abscess. There were no complications noted at 6 weeks postoperatively.

The trans-mastoid approach to otogenic MCF abscesses offers an alternative approach to traditional craniotomy or burr-hole drainage in select patients. The benefits include decreased overall morbidity of surgery due to decreased operative time, single postauricular incision, and lack of need for pinning of the head. Furthermore, the establishment of communication between the mastoid and middle fossa epidural space allows for gravity-dependent egress of any residual fluid and potentially reduces the risk of abscess recurrence. We pursued surgical intervention in abscesses over 1 cm in size. It is unclear regarding the maximal size of the abscess drainable through the tegmen, though the largest abscess drained measured 6.3 cm in size. We also recommend the close involvement of pediatric neurosurgery colleagues, as their familiarity with the intracranial space helped to guide accurate direction of dissection towards the abscess cavity.

We recommend that the transmastoid approach should be limited to cases where the fluid collection is located in the MCF epidural space. A careful review of imaging should be performed to select cases in which dissection towards the fluid collection is relatively straightforward and limited. In cases in which difficult access through a <1 × 1 cm tegmen window is anticipated, we advise against this approach to limit the risk of dural perforation or venous bleeding. For small abscesses, <1 cm or multi-loculated abscesses, intraoperative neuronavigation may be considered, although this was not used in any of our cases.

Limitations of this approach include the increased risk of development of delayed temporal lobe encephalocele with leaving an open tegmen defect. These are rare. Between 1950 and 1998, there were only 177 reported cases of meningocele

and meningoencephalocele, with the majority following mastoidectomy. In a six-patient case series of patients with delayed temporal lobe encephaloceles following trauma, mastoidectomy, or cholesteatoma, five out of six of the bony defects were 1.0 × 1.0 cm or greater.[17] However, we anticipate the risk of late temporal encephalocele to be very low. In each of our cases, the size of the tegmen defects was <0.7 × 0.7 cm. If there was any concern for dural thinning related to the drilling of the tegmen mastoideum, as was the case in patient number two, a Duragen onlay was applied to the dural surface at the conclusion of epidural abscess evacuation, which will result in the formation of a collagenous membrane and limit the potential for encephalocele formation. No temporal lobe encephalocele was noted on a 6-week postoperative MRI. The use of an extended course of intravenous antibiotics likely also helped to prevent disease recurrence and infection through a residual tegmen defect.

A potential limitation of accessing the intracranial space through a small tegmen window is suboptimal exposure of the MCF and difficult access to the area of infection. However, epidural abscesses are confined within spaces of dural adherence to suture lines and can be successfully managed with limited exposure techniques compared to deeper infections, such as subdural empyema.[10] Furthermore, our senior author's experience with surgical management of epidural abscesses is that purulent material within the epidural space tends to be less fibrinous than purulent material within the subdural space and thus more amenable to limited-access drainage techniques.

Author's contributions

MF was responsible for project design, manuscript preparation, and manuscript editing. AV was responsible for manuscript preparation and manuscript editing. BH was responsible for project design and manuscript editing. VT was responsible for project design and manuscript editing.

CONCLUSION

A transmastoid approach through the tegmen provides an alternative approach to otogenic epidural abscesses of the MCF. Collaboration between pediatric otolaryngology and neurosurgery can allow for a single-stage surgery without the need for craniotomy or burr-hole drainage that is both safe and efficacious.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

REFERENCES

1. Block SL, Harrison CJ, Hedrick JA, Tyler RD, Smith RA, Keegan E, *et al.* Penicillin-resistant *Streptococcus pneumoniae* in acute otitis media: risk factors, susceptibility patterns and antimicrobial management. Pediatr Infect Dis J 1995;14:751-9.
2. Duygu E, Şevik Eliçora S. Our experience on the management of acute mastoiditis in pediatric acute otitis media patients. Int J Pediatr Otorhinolaryngol 2020;138:110372.
3. Go C, Bernstein JM, de Jong AL, Sulek M, Friedman EM. Intracranial complications of acute mastoiditis. Int J Pediatr Otorhinolaryngol 2000;52:143-8.
4. Goldstein NA, Casselbrant ML, Bluestone CD, Kurs-Lasky M. Intratemporal complications of acute otitis media in infants and children. Otolaryngol Head Neck Surg 1998;119:444-54.
5. Hafidh MA, Keogh I, Walsh RM, Walsh M, Rawluk D. Otogenic intracranial complications. A 7-year retrospective review. Am J Otolaryngol 2006;27:390-5.
6. Heran NS, Steinbok P, Cochrane DD. Conservative neurosurgical management of intracranial epidural abscesses in children. Neurosurgery 2003;53:893-7.
7. Hlavin ML, Kaminski HJ, Fenstermaker RA, White RJ. Intracranial suppuration: A modern decade of postoperative subdural empyema and epidural abscess. Neurosurgery 1994;34:974-80.
8. Isaacson B, Mirabal C, Kutz JW, Lee KH, Roland PS. Pediatric otogenic intracranial abscesses. Otolaryngol Head Neck Surg 2010;142:434-7.
9. Kangsanarak J, Fooanant S, Ruckphaopunt K, Navacharoen N, Teotrakul S. Extracranial and intracranial complications of suppurative otitis media. Report of 102 cases. J Laryngol Otol 1993;107:999-1004.
10. Lundy P, Kaufman C, Garcia D, Partington MD, Grabb PA. Intracranial subdural empyemas and epidural abscesses in children. J Neurosurg Pediatr 2019;24:14-21.
11. Mattos JL, Colman KL, Casselbrant ML, Chi DH. Intratemporal and intracranial complications of acute otitis media in a pediatric population. Int J Pediatr Otorhinolaryngol 2014;78:2161-4.
12. Migirov L, Duvdevani S, Kronenberg J. Otogenic intracranial complications: A review of 28 cases. Acta Otolaryngol 2005;125:819-22.

13. Morwani KP, Jayashankar N. Single stage, transmastoid approach for otogenic intracranial abscess. J Laryngol Otol 2009;123:1216-20.
14. Park H, Jang H, Shim D, Shin H, Ahn J, Shin J. Surgical management of acute mastoiditis with epidural abscess. Acta Otolaryngol 2006;126:782-4.
15. Penido NO, Borin A, Iha LC, Suguri VM, Onishi E, Fukuda Y, *et al.* Intracranial complications of otitis media: 15 years of experience in 33 patients. Otolaryngol Head Neck Surg 2005;132:37-42.
16. Sexton GP, Nae A, Cleere EF, O'Riordan I, O'Neill JP, Lacy PD, *et al*. Concurrent management of suppurative intracranial complications of sinusitis and acute otitis media in children. Int J Pediatr Otorhinolaryngol 2022;156:111093.
17. Souliere CR Jr., Langman AW. Combined mastoid/middle cranial fossa repair of temporal bone encephalocele. Skull Base Surg 1998;8:185-9.
18. Sun J, Sun J. Intracranial complications of chronic otitis media. Eur Arch Otorhinolaryngol 2014;271:2923-6.
19. Van der Poel NA, van Spronsen E, Dietz de Loos DA, Ebbens FA. Early signs and symptoms of intracranial complications of otitis media in pediatric and adult patients: A different presentation? Int J Pediatr Otorhinolaryngol 2017;102:56-60.
20. Voudouris C, Psarommatis I, Nikas I, Kafouris D, Chrysouli K. Pediatric masked mastoiditis associated with multiple intracranial complications. Case Rep Otolaryngol 2015;2015:897239.
21. Wanna GB, Dharamsi LM, Moss JR, Bennett ML, Thompson RC, Haynes DS. Contemporary management of intracranial complications of otitis media. Otol Neurotol 2010;31:111-7.
22. Zapalac JS, Billings KR, Schwade ND, Roland PS. Suppurative complications of acute otitis media in the era of antibiotic resistance. Arch Otolaryngol Head Neck Surg 2002;128:660-3.
23. Zevallos JP, Vrabec JT, Williamson RA, Giannoni C, Larrier D, Sulek M, *et al.* Advanced pediatric mastoiditis with and without intracranial complications. Laryngoscope 2009;119:1610-5.

How to cite this article: Feng M, Vacaru A, Thimmappa V, Hanak B. Drainage of middle cranial fossa epidural abscess through mastoidectomy: Our experience and review of the literature. Surg Neurol Int. 2024;15:389. doi: 10.25259/SNI_674_2024

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Journal or its management. The information contained in this article should not be considered to be medical advice; patients should consult their own physicians for advice as to their specific medical needs.