Management of Brain Abscess and Lateral Sinus Thrombosis of Otogenic Origin: A Multidisciplinary Team Approach and Review of Literature


ORL-HNS (ENT) and Neurosurgery Sections, Departments of Surgery, Radiology and Medicine-Infectious Diseases
Hamad Medical Corporation, Doha, Qatar

Abstract:
In this era of antibiotics the incidence of brain abscess and lateral sinus thrombosis (LST) secondary to chronic suppurative otitis media (CSOM) should not be underestimated and the management still remains a clinical challenge. We review the clinical records of patients who presented with temporal lobe abscess (Case 1), cerebellar and extradural abscess (Case 2) and LST (Case 3) of otogenic origin and discuss the importance of multidisciplinary team approach in the management of these high-risk cases. We review the literature in detail and discuss the epidemiology, clinical presentation, diagnostic modalities, treatment options and controversies in the management of brain abscess and LST.

Introduction:
Antimicrobial agents have greatly reduced the incidence of intracranial complications of chronic suppurative otitis media (CSOM). Prior to the antibiotic era, intracranial complications occurred in 2.3 percent of cases (1,2). In many cases, cholesteatoma still remains a major risk factor in many parts of the World (1~6). The management of brain abscess and lateral sinus thrombosis (LST) of otogenic origin involves a multi-disciplinary team approach, including an otolaryngologist to eradicate the primary focus in the ear and a neurosurgeon to manage the intracranial complications. The team also includes a neuroradiologist to perform the radiological investigations to confirm the clinical diagnosis and to follow up the progress of treatment plus an infection control team to treat the infections based on the available local epidemiological data and culture reports.

Brain abscess is a serious life threatening infection and most otogenic brain abscesses develop in the temporal lobe and the cerebellum. The annual risk of an adult with active CSOM developing brain abscess is about 1 in 10,000 (7). Currently, brain abscesses account for 6-66.4% of otogenic intracranial complications and three per cent of patients with chronic otitis media develop brain abscesses (2) with a reported mortality rate of between 3.8 and 50 percent (3).

The clinical picture of lateral sinus thrombosis (LST) has changed with the advent of antibiotics and may be difficult to diagnose because of a lack of specific symptoms and an overlap of clinical findings with other conditions such as meningitis. The incidence of LST has been reported at between 17.4% and 19% (3) with a mortality rate ranging between 10-36% (2,6~8). To the best of our knowledge, management of LST has not been reported from Qatar.

Clinical Records:
Case 1: A 28 year-old male was admitted with ten-day history of headache, vomiting and vertigo and a history of right ear discharge with hearing loss for two years. Clinical examination of the right ear showed a perforated tympanic membrane with granulation tissue and a foul smelling mucopurulent discharge. Neurological examination revealed a conscious, well-oriented patient with mild sensory aphasia. There was no nystagmus or neck rigidity. Urgent computerized tomographic (CT) scans of temporal bone and brain showed a 5.5 x 3.8 cm right temporal lobe abscess (Figure 1a) and bone destruction in the mastoid antrum and tegmen tympani on the same side (Figure 1b). The patient underwent emergency burr hole aspiration of the right temporal lobe abscess by the neurosurgeons and approximately 50 ml pus was aspirated and sent for bacteriological culture.

After 48 hours the patient underwent right modified radical mastoidectomy to eradicate the primary focus. Cholesteatomata and granulation tissue were removed from the mastoid and middle ear and the bony plate separating the mastoid antrum and the dura (tegmen tympani) was found to be eroded by the disease.

Bacteriological cultures grew Proteus vulgaris, Streptococcus milleri and Peptostreptococcus species and the patient re-

Address for correspondence:
Dr. Shanmugam Ganesan
MBBS, FRCS (Ed&Glasg), FRCS Ed (ORL-HNS), DLO
ORL-HNS (ENT) Section, Department of Surgery
Hamad Medical Corporation, P.O. Box 3050, Doha, Qatar
Fax: 4393239; E-mail: ganesan5564@hotmail.com
Management of Brain Abscess and Lateral Sinus Thrombosis... Ganesan S., et al.

Figure 1a: Pre-operative CT scan showing an abscess cavity in the right temporal lobe with surrounding edema.

Figure 1b: Pre-operative high resolution CT scan of petrous bone showing bone destruction in the mastoid antrum and tegmen tympani (right side).

Figure 1c: Post-operative contrast enhanced CT scan shows resolution of abscess (right side).

Received a multiple antibiotic regime according to the sensitivity pattern, closely followed by the multi-disciplinary team. The patient was discharged home after six weeks with no neurological sequelae. Figure 1c is a post-operative follow up CT scan showing complete resolution of the abscess.

Case 2: A 23 year-old female presented with headache, giddiness and otalgia for 10 days, with fever and vomiting for two days. She had recurrent left ear discharge with hearing loss since childhood. Clinical examination of the left ear showed a foul smelling mucopurulent discharge with posterior superior marginal perforation and evidence of cholesteatoma. There was

Figure 2a: Pre-operative contrast enhanced coronal MRI demonstrating an extradural collection, meningeal enhancement and a small cerebellar abscess (left side).

Figure 2b: Post-operative contrast enhanced axial CT scan showing complete resolution of extradural abscess and residual cerebellar abscess (left side).
no nystagmus or neck stiffness. The gait was normal. Urgent CT scan of temporal bone and brain revealed soft tissue opacity in the left middle ear and mastoid and an extradural abscess. Further MRI study showed a small left cerebellar abscess and an extradural abscess (Figure 2a). The patient underwent emergency radical mastoid surgery and an extensive cholesteatoma was removed from the middle ear and mastoid. The extradural abscess was drained through the mastoid cavity with the help of the neurosurgeons.

As the cerebellar abscess was small, it was managed conservatively with antibiotics and follow-up scans by the neurosurgeons. Bacterial culture from the ear specimen grew *Morganella morgani* and *Enterococcus ovum* and a multi-antibiotic regime was used based on the sensitivity pattern. The patient was discharged home after six weeks without any neurological sequelae and the patient continued oral antibiotics for a further 10 weeks until there was complete resolution of the cerebellar abscess. Figure 2b is a follow-up CT scan at five weeks showing complete resolution of the extradural and residual cerebellar abscesses.

**Case 3:** A 28 year-old male presented with fever, dizziness and headache for three days and vomiting for one day. He had bilateral discharging ears with hearing loss for many years. Clinical examination of the right ear showed a mucopurulent discharge, swelling of the postero-superior external auditory canal wall and posterior marginal perforation of the tympanic membrane. There was no post-auricular cellulitis or abscess. The left ear showed inactive central perforation of the tympanic membrane. There was no nystagmus or neck rigidity. The rest of the neurological examination was normal. Urgent CT scan of temporal bone and brain showed soft tissue opacity of the middle ear and mastoid with LST on the right side. Figure 3a shows the axial CT scan at the level of C1 vertebra showing a thrombus in the IJV. Subsequent magnetic resonance imaging (MRI) and a magnetic resonance venogram (MRV) confirmed the diagnosis of LST (Figures 3b and 3c). The patient underwent emergency right ear mastoid exploration and extensive granulation tissue was removed from the mastoid antrum and minimal cholesteatoma from the aditus ad antrum. The lateral sinus appeared as a cord-like structure and was found to be thrombosed on needle aspiration. No attempt was made to open the sinus.

Bacteriological specimens sent for culture grew *coliforms* and multiple antibiotic therapy was used based on the sensitivity pattern. He also received anticoagulation treatment for three weeks. The patient was discharged home after four weeks without any neurological sequelae.

**Discussion:**

Infection from the ear, whether acute or chronic, may spread to intracranial structures by a number of possible routes which include: i) direct extension through bone by either cholesteatoma or osteitis in chronic ear disease, ii) by thrombophlebitis of small veins via bone and dura to venous sinuses, and iii) to intracranial structures through preformed pathways such as the labyrinth and the endolymphatic channels and iv) through developmental or traumatic bony defects.

![Figure 3a: Contrast enhanced axial CT scan at the level of C1 vertebra showing thrombus in the IJV (right side).](image1)

![Figure 3b: Contrast enhanced coronal MRI showing an abscess in the right mastoid, meningeal thickening and thrombus in the IJV.](image2)

![Figure 3c: MR Venography demonstrating poor visualization of right lateral sinus with a thrombus extending to the level of confluence of venous sinuses (right side).](image3)
Management of Brain Abscess and Lateral Sinus Thrombosis

With the advent of powerful antibiotics, improved imaging and surgical techniques, the incidence of complications has reduced to 0.04 - 0.15 percent but the morbidity and mortality remains high\(^{14}\). The incidence of intracranial complication of otogenic origin is higher in males and most complications arise from chronic otitis media\(^{10}\). In 1935 Katka studied 2,100 patients with acute mastoiditis and 1,125 patients with chronic mastoiditis. Two hundred and nine (6.4%) of the 3225 patients developed an intracranial complication with a mortality of 76.4%.

The most important factors in making an early diagnosis are careful history taking and physical examination and a high index of suspicion for impending complications. Patients with discharging ears warrant urgent attention if they develop one or more of the following symptoms: persistent headache, vomiting, irritability, otalgia and dizziness\(^{2,9}\). Among the intracranial complications, meningitis is still the most common followed by brain abscess and lateral sinus thrombosis (LST). Otogenic meningitis rarely occurs alone and it usually occurs with other intracranial or intratemporal complications of otitis media\(^{9}\).

None of our patients had signs of meningitis and lumbar puncture was not performed routinely.

Brain abscess is the most serious of otogenic complications and therefore requires early diagnosis and treatment. Otogenic brain abscess most commonly occurs in the temporal lobe or the cerebellum of the same side of the infected ear and is three times more common in males. Temporal lobe abscess is twice as common as cerebellar abscess\(^{2,9,10}\). The most common route for the spread of infection is by direct extension through an osseous bone or thrombophlebitis of the small veins. In three per cent of cases, multiple abscesses were found\(^{6}\). One of our patients (Case 2) presented with a cerebellar abscess and an extradural abscess. Nunez and Browning reported that 41 of 44 otogenic brain abscesses (95%) were from chronic otitis media and 41% of patients were found to have a cholesteatoma\(^{7}\).

Kangsanarak et al., in their 13 years of experience with intracranial complications of suppurative otitis media noted that 29 of 87 of their patients had cholesteatoma\(^{21}\). In our series, both Case 1 and Case 2 had cholesteatoma.

The initial management of brain abscess consists of confirmation of diagnosis by CT or MRI scanning and stabilizing the patient. The timing of the neurosurgical procedure and the otological surgery must be determined on an individual basis. Surgery for the brain abscess includes aspiration through a burr hole or formal craniotomy, open drainage and, rarely, total excision\(^{8}\). Surgical treatment to the primary focus in the ear may be performed at the time of neurosurgical procedure or at a separate time if the intracranial problem is of such severity that it should be managed first. In Case 1, initially neurosurgeons drained the temporal lobe abscess through a burr hole and after 48 hours, once the patient was stabilized, we performed the mastoid surgery to eradicate the primary focus.

Many studies have confirmed a high incidence of polymicrobial infection in brain abscess patients and are generally similar to the primary infection in the ear\(^{12,9,11,12}\). Broad-spectrum antimicrobial agents are administered as soon as possible pending the availability of specific culture reports. Both Case 1 and Case 2 had more than one organism identified from the culture. Occasionally, intravenous antibiotics are recommended as the sole management of brain abscess\(^{12}\). In Case 2, multi-drug intravenous antibiotics were administered for six weeks and oral antibiotics for a further ten weeks with follow up CT scanning as the exclusive treatment for cerebellar abscess. The extracranial abscess was drained at the time of mastoid surgery.

In the era of antibiotics, the presentation of LST has changed to vague and non-specific symptoms. The classical "picket-fence" spiking fever is a cardinal feature no longer. The decreased incidence and change in presentation requires clinicians to have a high index of suspicion to make the diagnosis. Our patient (Case 3) presented with unilateral headache, giddiness, vomiting and fever without signs of septicemia and long-standing history of CSOM. The lateral sinus comprises the sigmoid and transverse sinuses and the thrombus may extend upwards to the confluence of the sinuses, to the superior sagittal sinus and to the cavernous sinus. Downward propagation of the thrombus through the internal jugular vein can occasionally reach the subclavian vein\(^{2}\). In our case, the thrombosis was found to spread up to the confluence of sinuses and downward into the jugular vein in the neck. LST is more common in chronic otitis media than in acute otitis media and the cultures characteristically yield a polymicrobial origin including bacteroides, streptococci, Enterobacteriaceae and other Gram-negative rods\(^{2,6,7,9,11}\). In our patient, *coliforms* grew from the ear specimen sent for culture.

A CT scan is of great importance in an early investigation to rule out other associated intracranial complications in suspected cases. It may show abnormal high density of the lumen of the sinus, which does not enhance after intravenous contrast medium. Enhancement of the dura surrounding the sinus may be prominent, causing an empty triangle or 'delta sign', which may suggest the diagnosis\(^{13}\). The confirmation of LST is by MRI and/or MRV and by surgical exploration of the lateral sinus\(^{7,9,10}\).

Review of the literature shows considerable controversy in the surgical treatment of LST and the role of anticoagulation. Most authors agree on a broad spectrum multiple antibiotic regime and early intervention within 48 hours of presentation to remove the primary focus in the mastoid. Mastoid surgery includes removal of granulation tissue and cholesteatoma if present and clearing of peri-sinus cells including necrotic bone. The sinus plate must be uncovered and a small needle should be
inserted through the wall to confirm the absence of free flow of venous blood. Many authors do not insist on free bleeding at the LST site\textsuperscript{6-8}. Our patient (Case 3) had mastoid exploration and removal of granulation and cholesteatoma. During surgery we found the lateral sinus to be indurated and cord-like. We decided not to explore the sinus and remove the thrombus due to the extension of the thrombus beyond the boundaries of mastoid. In this case the thrombus propagated upwards to the confluence of sinuses and downward to the internal jugular vein in the neck. Post-operative clinical monitoring and radiological investigations were used to assess the progress of the patient.

Many investigators have opposed the use of anticoagulation in LST because of the frequent occurrence of intracranial hemorrhage (ICH). Einhaupl et al. believed that anticoagulation with dose adjusted intravenous heparin was an effective treatment in patients with sinus venous thrombosis\textsuperscript{14}. Syms et al., suggested a low dose of subcutaneous heparin (5000 units) for prophylaxis against deep vein thrombosis in LST patients\textsuperscript{8}. Most authors agree that there is no regular place for anticoagulation except in cases where a spreading thrombus has reached the cavernous sinus\textsuperscript{9}. In our case, we decided to use anticoagulation because of the extent of the thrombus to the confluence of sinuses and to prevent further propagation to the superior sagittal sinus and cavernous sinus. Our patient received anticoagulation for three weeks as advised by the hematologist (heparin 10,000 units initially for 10 days and then dose-adjusted warfarin to keep the INR above two for two weeks) and did not suffer any side effects.

The controversy regarding the indications for ligation of IJV still exists in the literature. Many authors have presented rational arguments for and against ligation of IJV. Jenson (1962) argued against IJV ligation in the treatment of LST and Proctor (1966) suggested that the ligation should be done when the clot extends beyond the mastoid area. Teichgraeber et al., reviewed the literature in detail and summarized that IJV ligation should be reserved for those patients with septicemia and signs of embolism and in patients not responding to initial surgery and intravenous antibiotics. Also, it should be considered for children showing signs of embolization. Recent literature supports IJV ligation for specific indications as suggested by Teichgraeber et al., and should be reserved as a last resort when initial treatment fails\textsuperscript{2,6,11,12,13}. We agree with this view; our patient did not require IJV ligation and recovered completely with early mastoid surgery and aggressive medical treatment.

**Conclusion:**

Review of recent literature indicates that the incidence of brain abscess and LST secondary to chronic otitis media has been decreasing. However, even with the advent of modern imaging techniques, powerful antibiotics and aggressive surgical approach, the morbidity and mortality remain high. The most important factor in making early diagnosis of impending intracranial complications in patients with chronic discharging ears are careful history, physical examination and a high index of suspicion. We stress the importance of close cooperation between Otolaryngologists, Neurosurgeons and other associated specialties.

**References:**