CASE REPORT

Transmastoid repair of delayed traumatic cerebrospinal fluid (CSF) leak in a paediatric patient with skull base fracture

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SUMMARY

Cerebrospinal fluid (CSF) leakage is one of the complications of skull base fracture. This condition carries significant morbidity and mortality. We report a case of delayed onset traumatic CSF otorrhoea in a nine-year-old boy with a history of traumatic head injury sustained five years prior. He presented with a new onset of seizure associated with fever and was admitted with a diagnosis of meningoencephalitis. Further history revealed right ear discharge noted a day prior to the admission. Imaging studies depicted a defect on the right tegmen tympani creating a communication between the middle ear, posterior cranial fossa and external ear canal. Following resolution of acute infection, right mastoid exploration and trans-mastoid approach for tegmen tympani repair were done. The child had no further seizure episodes and recovered well.

INTRODUCTION

CSF otorrhoea occurs when there is a discontinuity in the tegmen tympani or mastoideum accompanied by breaching of the overlying mucosa, dura and arachnoid mater.[1] Post-traumatic CSF otorrhoea carries a mortality rate of 8.5%.[2] Additionally, 8% of petrous temporal bone fracture cases are complicated by CSF leak, while 19% result in persistent hearing loss.[3] Fatal complications of CSF otorrhoea include persistent CSF fistulae, meningitis and encephalitis.[2]

CASE PRESENTATION

A nine-year-old boy with a history of traumatic brain injury at the age of five, who achieved full neurological recovery except for reduced hearing in the right ear, presented with a three-day history of fever along with headache and vomiting. He experienced an episode of generalised tonic clonic seizure which lasted for less than five minutes prior to admission. There was no prior history of seizures, ear or nasal discharge since the trauma. On examination, the patient was alert, fully conscious and obeying command. His vitals were stable with no new onset focal neurological deficit. The patient was admitted to the paediatric ward and further investigation including blood investigation, lumbar puncture and computed tomography scan of brain were done.

The blood investigation showed raised total white cell count of 26.24 $\times 10^3$µL, predominantly neutrophilic. A plain computed tomography (CT) scan of brain demonstrated soft tissue density within the right middle ear and mastoid air cells. Based on his clinical presentation, he was treated for meningoencephalitis with broad spectrum antibiotics and anticonvulsant. However, subsequent CSF cytology and culture results were normal.

Following the CT scan findings, further questioning revealed an episode of copious clear right ear discharge. The patient was referred to Ear, Nose and Throat (ENT) team for an expert evaluation. Otoscopic examination revealed granulation tissue within the right external auditory canal (EAC). A high-resolution computed tomography (HRCT) scan of temporal revealed a 1cm defect in the right tegmen tympani, creating a communication with the middle ear, posterior cranial fossa and external ear canal (Fig. 1).

Right mastoid exploration was performed once the infective parameters had normalised. The postauricular skin incision was made 1cm posterior to the right post-auricular sulcus and extending inferiorly slightly beyond mastoid tip to harvest sternocleidomastoid muscle and cervical fat graft. Intra-operatively, a pseudomembrane in the lateral one third of the right EAC was observed, with cholesteatoma to it eroding the proximal part of posterior EAC wall. A gush of CSF from the middle ear was observed upon removing the granulation tissue and cholesteatoma while raising the TM flap. The tympanic membrane and middle ear structures were otherwise intact.

There was a 1 cm defect over the right tegmen tympani communicating with the middle cranial fossa noted (Fig. 2). The defect with its fistula tract and the mastoid cavity were filled up by granulation tissue. Tegmen tympani defect repair was performed in multilayers; using a layer of collagen-based dura patch, followed by a layer of crashed sternocleidomastoid muscle graft, and then a layer of bone dust followed by the superior base flap. Subsequently, fibrin glue was used to fix and stabilized the layers that were placed. The mastoid cavity and the aditus were obliterated with infra-auricular fat graft fixed with the fibrin glue as

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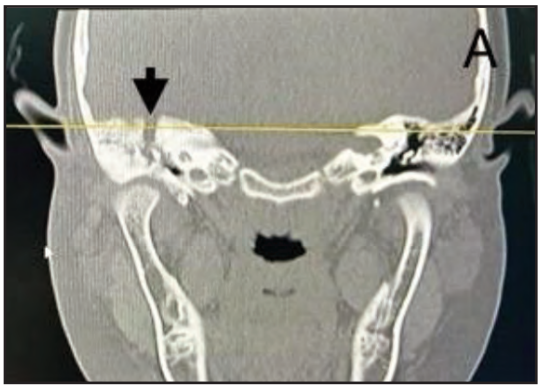

Fig. 1: Coronal view with the black arrow showing the defect in the right tegmen tympani creating a communication with the middle ear, posterior cranial fossa and external ear canal

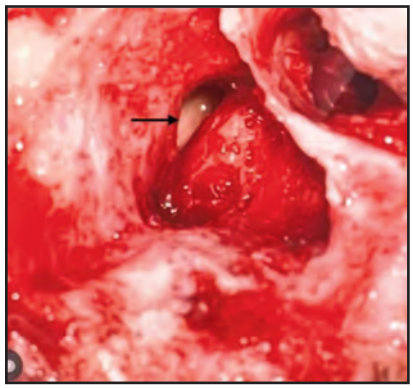

Fig. 2: A microscopic view of cortical mastoidectomy showing at the defect of right tegmen tympani (black arrow)

mastoid obliteration. A small piece of muscle was plugged at the attic and the posterior canal defect. Tympanoplasty was performed using temporalis fascia graft as part of mastoid obliteration with middle ear reconstruction.

The middle ear and mastoid cavity were filled with the Gelfoam. Bismuth iodoform paraffin paste ribbon gauze was placed in the ear canal. Skin incision was closed interruptedly with non-absorbable suture and mastoid dressing was applied.

Post-operative recover was unremarkable. The surgical wound was clean during wound inspection on day three post-operation.

The patient was discharged on post-operative day six with a two-week course of oral antibiotics. At the next follow-up visit, the patient was remained well, with a fully healed postauricular incision and an intact tympanoplasty graft in place.

DISCUSSION

CSF is a clear, colourless and odourless fluid with different glucose and protein content as compared with plasma. Beta-2 transferrin assay has 100% sensitivity but it requires 2-5ml of CSF sample to achieve a higher sensitivity of 84%.[4] Besides, this assay is not widely available. Other laboratory test such as glucose oxidase test has poor diagnostic sensitivity and specificity and is not recommended as a diagnostic test.[1,4] A detail history taking is essential to alert physician the presence of CSF otorrhoea or otorhinorrhoea.[1,5] In this case, CSF otorrhoea was diagnosed clinically as laboratory test was not available.

The overall prevalence of petrous temporal bone fractures among the paediatric age group with skull fracture was 7%.[3] Petrous temporal bone fracture carries significant risk of acute and chronic complications including facial nerve palsy, hearing loss, CSF leak and neurological injuries.[3] The residual right ear hearing reduction is an alarming sign of high impact traumatic brain injury with petrous temporal bone fracture. A long-term follow-up for this case is essential for early detection of the complication. Unfortunately, the patient had defaulted follow up after the trauma and represented with complicated CSF otorrhoea.

Imaging study such as HRCT aids in identifying the size and location of the osseous defect. This is an important guide for surgical planning.[6] In this case, HRCT temporal was done prior to the surgical planning to identify the location of the bony defect.

Majority of the traumatic CSF otorrhoea cases can be managed conservatively.[1,6] However, in the case of persistence CSF otorrhoea, iatrogenic, intermittent leaks, associated with skull base tumours or complicated case with meningitis, surgical intervention is the mainstay of treatment.[1,6] Surgical approach is based on the site and size of the osteodural defects, hearing status of the patient and the surgeon's experience.[6,7,8] Transmastoid approach using postauricular incision and mastoidectomy allows access to the tegmen. Study suggested less than 1cm tegmen defect without CSF leak could treat conservatively, 1-2cm tegmen defect with or without fistula or less than 1cm with CSF leak should repair through transmastoid approach, larger than 2cm defect or failed previous repair should repair through combined approach (transmastoid with minicrabiotomy).[6,9] In this case, the tegmen mastoideum defect was 1cm with fistula and CSF leak, hence, transmastoid approach was choosen. A graft is placed through the tegmen defect in between dura and the superior edge of the tegmen. It can be reinforced with bone dust.[7] The choice of material for closure is based on the size of the defect and the presence of CSF leak.[9] Temporal fascia is used for defect less than 1cm; temporal fascia and auricular cartilage are used for defect 1 and 2cm; temporal fascia, auricular cartilage and bone from craniotomy are used for defect larger than 2cm. If CSF leak present, multilayer technique is indicated regardless the size of the defect. Fibrin glue is preferred for the adherence of the materials to the brain tissue.[7,9] In this case, in view of the tegmen defect was associated with CSF leak, multilayer technique was done using collagen-based dura patch, crashed sternocleidomastoid muscle graft, bone dust and superior base flap. Fibrin glue was used as the adherence material.

CONCLUSION

Detail history and high index of suspicion are important to diagnose CSF otorrhoea in the paediatric age group. Long term follow-up for paediatric petrous bone fracture is important for early detection of the complication. HRCT is useful to demonstrate the bone anatomy and defects which facilitates in surgical planning. The approach of surgery for lateral skull base defect is based on the size of the defect and the association of CSF leak.

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DECLARATION

The authors declare that they are compliant with standards, no funding involved, no conflict of interest and ethical approval and informed consent are obtained.

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