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Cerebrospinal fluid (CSF) otorhinorrhoea following vestibular schwannoma surgery treated by extended subtotal petrosectomy with obliteration

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Abstract

Extended subtotal petrosectomy as a treatment for persistent cerebrospinal fluid (CSF) otorhinorrhoea is presented. Four patients were successfully operated on by this technique, all previously having undergone suboccipital removal of vestibular schwannoma: other interventions used had failed to seal the fistulae. The internal auditory canal was the usual pathway for CSF leakage as well as retrosigmoid, retrolabyrinthine, retro- or perifacial cells. Total exenteration of middle ear and mastoid cell tracts, skeletonization of sigmoid sinus, jugular bulb and facial nerve, drilling out of semicircular canals, vestibule, and cochlea, and skeletonization of the internal auditory canal, followed by obliteration, are the main steps of this approach.

Key words: Cerebrospinal otorrhoea; Schwannoma, vestibular, complications; Petrous bone, surgery

Introduction

Cerebrospinal fluid (CSF) otorrhoea may occur following brain and base of skull surgery, temporal bone fractures, tumours with erosion of the temporal bone, and congenital anomalies, particularly those of the inner ear, as in Mondini dysplasia. Rarely complications of chronic middle ear disease, ear and mastoid surgery and spontaneous cases occur (Myers and Sataloff, 1984; Wetmore *et al.*, 1987). Although readily treated in most cases, it presents in some a dangerous and life-threatening problem. The cases following surgery are usually easy to diagnose, the CSF leakage found along the path of the operative injury; in others recognition of the leakage may be more difficult. Three routes have been reported for CSF entry into the middle ear – the internal auditory canal, the cochlear aqueduct, and the mastoid air cells (Watanabe *et al.*, 1979; Harner and Laws, 1982). In paradoxical rhinorrhoea (Walker, 1956) the eustachian tube provides the pathway for CSF from the middle ear cavity to the nose.

Fisch and Pillsbury (1979) introduced subtotal petrosectomy as part of the infratemporal type A approach for infralabyrinthine and petrous apex lesions, infratemporal type B approach for tumours of the clivus, and infratemporal type C approach for parasphenoid, parasellar, and nasopharyngeal tumours. As treatment for CSF otorrhoea, it was first described by Coker *et al.* (1986). We have extended that approach to the inner ear to seal all possible pathways for CSF leakage.

We present four patients who underwent extended subtotal petrosectomy for persistent CSF otorhinorrhoea, all previously having undergone surgical removal of vestibular schwannoma; other interventions had failed to seal the fistulae.

Surgical technique

Subtotal petrosectomy attempts to exenterate and obliterate all accessible pneumatized spaces of the temporal bone with preservation of the otic circumference, facial nerve, and a cortical plate over the carotid artery, middle and posterior cranial fossae. The extended operation is performed in four main steps:

(1) blind sac closure of the external auditory canal;
(2) complete exenteration of middle ear and mastoid cells;
(3) drilling out the inner ear cavities and skeletonization of the internal auditory canal;
(4) obliteration of the middle ear, eustachian tube and mastoid cavity.

Through a post-auricular incision, an anteriorly based subcutaneous-periosteal flap is elevated, the external auditory canal cut, and the skin of the lateral part of the external canal everted and sutured. After blind sac closure of the external canal, secured by the subcutaneous-periosteal flap, total exenteration of the middle ear and mastoid cell tracts is performed, including the retrosigmoid, retrofacial, posteromedial, posterosuperior, subarcuate, epitympanic, supralabyrinthine, peritubal and infralabyrinthine cells. All mucosa is removed and the bone polished with diamond burrs. A thin, bony, plate is left over the carotid artery and the dura of the middle and posterior fossae. Skeletonization of sigmoid sinus, jugular

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TABLE I
DETAILS OF PATIENTS AND OUTCOME

Case no.	Age (years)	Presentation	Origin of leak*	Meningitis	Follow-up after obliteration (years)	Successful obliteration
1	58	Rhinorrhoea	IAC, RS	+	1	+
2	46	Rhinorrhoea	IAC, RL, RF	+	4	+
3	52	Otorrhoea	IAC, RS	–	5	+
4	53	Otorrhoea	IAC	–	1	+

*IAC: internal auditory canal; RS: retrosigmoid cells; RL: retrolabyrinthine cells; RF: peri- and retrofacial cells.

bulb, and facial nerve follows, from the stylomastoid foramen to the entrance of the nerve into the internal auditory canal. The semicircular canals, vestibule, and cochlea are completely drilled out and the internal auditory canal skeletonized. The eustachian tube is plugged with small pieces of muscle and Gelfoam, the surgical cavity obliterated with a free abdominal fat graft, and above it a large pedicled, rotated, temporalis muscle flap. Prophylactic antibiotic treatment and post-operative lumbar drainage were not employed. A pressure dressing was kept for three days.

Patients

Four patients following suboccipital removal of vestibular schwannoma were referred because of persistent CSF otorhinorrhoea. In all a re-exploration of the posterior fossa, use of Lyodura with cyanoacrylate tissue adhesive, and prolonged lumbar drainage had failed to close the fistula. Two patients suffered from recurrent meningitis. The sites of leakage are presented in the Table I.

All patients were operated on by the technique described. No recurrent CSF otorhinorrhoea or episodes of meningitis were seen after surgery. Follow-up periods were one to five years.

Discussion

Glasscock *et al.* (1978) report that the incidence of post-operative CSF otorrhoea in vestibular schwannoma varies from six to 30 per cent. Most can be easily managed during the original surgery, but in some the leak remains unrecognized until later. The dural defect in such cases can be up to 2 cm in diameter and cannot seal off spontaneously. CSF otorrhoea is usually diagnosed easily on otoscopy when fluid is seen in the middle ear. When the tympanic membrane is not perforated, paradoxical rhinorrhoea results. X-ray studies are not of localizing value in many cases and the use of radioactive tracers will confirm the obvious diagnosis.

The degree of pneumatization of the petrous temporal bone is a major factor in CSF fistula aetiology. Highly pneumatized bones are more prone to leak and primary intracranial closure of the defect is less effective (Coker *et al.*, 1986).

Treatment options for CSF otorrhoea have included flow-regulated continuous spinal drainage and intracranial or extracranial repair. The first method as recommended by Swanson *et al.* (1985) is for small fistulas but is effective only if started immediately and requires bed rest of at least seven days. The intracranial posterior fossa approach can be difficult, the identification of the fistula in many cases impossible, sealing of multiple small defects in the skull base ineffective, and moreover it carries significant morbidity (Harner and Laws, 1982; Myers and Sataloff, 1984).

The areas of potential fistulae are the internal auditory canal and the mastoid air cells. Four cell tracts connect the internal auditory canal with the tympanic cavity: the subarcuate, the posterosuperior, the posteromedial, and the anterolateral. Drilling of the posterior wall of the internal canal from the posterior fossa in an attempt to remove the intracanalicular part of a tumour may open these cell tracts. The internal auditory canal was found in our patients to be the most commonly involved pathway for CSF leakage as well as the retrosigmoid cells, the retro- or perifacial cells, and the retrolabyrinthine cells. Rambo (1958) and Gacek (1976) have adopted obliteration of the mastoid cavity as a treatment for otorrhoea using fascia and adipose tissue. Solomons and Robinson (1988) used bone paté, and Ferrante *et al.* (1988) used fibrin glue. Anteriorly pedicled temporalis muscle to obliterate the radical mastoid cavity in chronic ear surgery was described by Rambo (1958) and Hicks *et al.* (1980). The use of autogenous material (abdominal fat) and a rotation muscle flap gives the best cosmetic and infection-resistant results. Subtotal petrosectomy with obliteration of the middle ear cleft seems to be an efficient solution for stubborn CSF otorrhoea (Fisch and Pillsbury, 1979; Coker *et al.*, 1986; Wetmore *et al.*, 1987). It differs from the mastoidectomy of chronic ear surgery in that all cell tracts, particularly the infralabyrinthine and peritubal tracts communicating with the middle ear, are exenterated. In our cases the CSF leakage was mainly through the internal auditory canal; therefore we find it advisable to extend this technique to the inner ear and skeletonize the internal auditory canal in order to seal possible leakage from this point. A reliable result can be achieved only by total exenteration of the temporal bone cavities, the semicircular canals, vestibule, and cochlea, with skeletonization of the internal auditory canal. This seems to be the best and safest method, although requiring close cooperation between the neurosurgeon and the neuro-otologist.

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