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Technique to prevent post-operative CSF leak in the translabyrinthine excision of vestibular schwannoma

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Abstract

Cerebrospinal fluid (CSF) leak following VS removal is a challenging complication. With experience, it can be seen that anatomical factors such as the extent of pneumatization of the petrous temporal bone and posterior wall of the internal auditory canal play an important role in contributing to CSF leak. Nevertheless, the risk of post-operative CSF leak remains a major concern for both the surgeon and patient. This paper describes a technique, which we have used since 1994, and which has helped us to achieve the lowest reported rate of post-operative CSF leak in translabyrinthine excision of vestibular schwannoma in the world literature.

Key words: Cerebrospinal Fluid Otorrhoea; Neuroma, acoustic/surgery

Introduction

With the advent and application of modern microsurgical techniques, the morbidity associated with vestibular schwannoma (VS) removal has been reduced considerably. Nevertheless, the risk of post-operative cerebrospinal fluid (CSF) leak remains a major concern for both the surgeon and patient. CSF leak, with its inherent risk of meningitis, occurs when a channel develops between the subarachnoid space and the pneumatized cavity of the temporal bone. CSF can follow any one of three potential pathways (in increasing order of frequency) – through the external auditory canal, through the wound and through the eustachian tube.[1]

Since the original report of CSF leak following the removal of a VS,[2] several techniques have been described in the literature to prevent this complication, which can necessitate an additional surgical procedure. Montgomery, in 1966,[3] started using abdominal fat to obliterate the operative cavity by placing a piece of fat (1–2 cm in diameter) in the labyrinthine defect, a second smaller piece in the mesotympanum and a final large piece in the mastoid cavity. Closure with fat has evolved over time from the use of a single large piece of fat for the obliteration of the cavity[4] to the placement of several long strips of fat in the cavity with the medial end of the strips protruding into the cerebellopontine angle. This latter technique results in closure of the dural defect like a 'champagne cork'.[5] Tos *et al.* in 1991 advocated the closing of the dural defect by gluing the fascia graft to the edges and then obliterating the cavity with strips of fat.[6]

Attempts to prevent post-operative CSF leak have also included sealing off the mastoid air cells. Bone wax,[7–9] free-muscle graft,[7,8] and fibrin glue[10,11] have all been used to attain this goal. Obliteration of the middle-ear space and eustachian tube with temporalis muscle and fascia lata after removal of the incus, head of the malleus and tensor tympani muscle, has also been proposed as an alternative technique.[12] In a refinement of this method, Glasscock removes the incus, opens the facial recess completely up to the stylomastoid foramen and then closes the eustachian tube with muscle.[13] Others report packing the middle-ear space and aditus with muscle pieces ('grains of rice') and further reinforcing it with bone wax, after removal of the incus.[14]

Against this background of divergent and varied techniques, the purpose of this report is to describe the surgical method that has been followed routinely in this centre since 1994 to prevent post-operative CSF leak in cases of VS operated upon using the enlarged translabyrinthine approach.

Surgical technique

The surgical incision is a standard U-shaped postauricular incision approximately two finger breadths superior to the pinna, three to four fingers behind the post auricular fold and extending inferiorly up to the mastoid tip. A subcutaneous flap is elevated, exposing the temporalis fascia, and retracted away from the operative site with hooks. A T-shaped incision is

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made in the musculofascial layer down to the bone, with the long arm of the incision extending to the mastoid tip. Anterior, superior and posterior fasciomusculoperiosteal flaps are elevated using a strong elevator and stitched to the skin respectively.[15]

With a large cutting burr, remains of the periosteum are collected from the exposed bone. A wide mastoidectomy is performed exposing the middle fossa dura, sigmoid sinus, sinodural angle and digastric ridge. During the bone work, as many cells as possible are exenterated from the mastoid tip, infralabyrinthine, supralabyrinthine and zygomatic regions. Cells which cannot be exenterated completely are packed with bone wax, after removing the mucosa from such cells. Particular care should be exercised at this stage not to open the facial and sub-facial (sinus tympani) recesses, which can result in the formation of a communicating channel between the subarachnoid space and the tympanic cavity. Following wide mastoidectomy, a complete labyrinthectomy is performed. The internal auditory canal (IAC) is identified and its contents are exposed to 270° around its circumference. During exposure of the IAC, suprameatal (petrous apex) and inframeatal (infralabyrinthine) apical cells can be encountered which are closed using bone wax as described above (Figure 1). Obliteration of the cell should be performed preferably soon after it is opened and certainly before opening the dura since it has been observed that once CSF comes in contact with the mastoid cells, closure becomes more difficult and less reliable.[1]

After tumour extirpation, the incus is disarticulated and removed from the tympanic cavity using a right angle pick. The movement for disarticulating the incus should follow a horizontal plane, parallel to the tympanic membrane, in order to avoid fracture/dislocation of the stapes foot plate. Thereafter the attic and middle ear are plugged with the dry periosteum that was collected at the start of the operation. The pieces of periosteum are pushed medial and lateral to the head of the malleus towards the tympanic cavity to obliterate the middle-ear space and also to achieve a watertight closure of the aditus (Figure 2).

Obliteration of the operative site is accomplished by packing it with long strips of abdominal fat in such a manner that part of the strips protrude into the cerebellopontine angle. No attempt is made to suture the dural edges.

The fasciomusculoperiosteal flaps are sutured in a watertight fashion. The skin flap is reflected back and fixed to the underlying musculofascial layer with two to three absorbable stitches, this prevents collection of blood or CSF underneath. Skin edges are sutured using black silk and a tight dressing is applied, which is kept in place for five days.

In difficult cases such as highly pneumatized temporal bone, the posterior canal wall is lowered down, and the canal skin with the tympanic membrane and ossicles is removed. Thereafter the mucosa is stripped from the middle ear and from the eustachian tube followed by packing the eustachian tube with muscle pieces, obliteration of the whole cavity with fat and finally closing the ear canal as described by Fisch.[16]

Material and methods

A retrospective review of the hospital records of patients operated for VS between April 1987 and December 2002 was performed. There were a total of 839 patients out of which 708 were operated on using the enlarged translabyrinthine approach (ETLA). The present technique was followed in the last 596 patients.

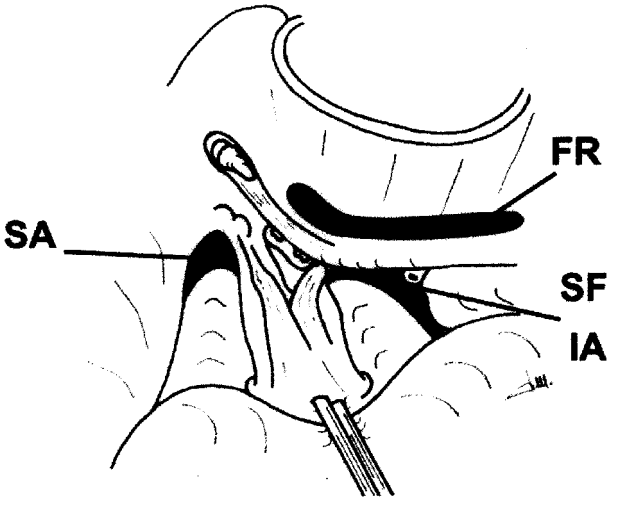

FIG. 1

Sketch of the right cerebellopontine angle and mastoid cavity showing various locations of the air cells which should be closed with bone wax before opening the dura.
SA = suprameatal; IA = inframeatal; FR = facial recess; SF = subfacial recess.

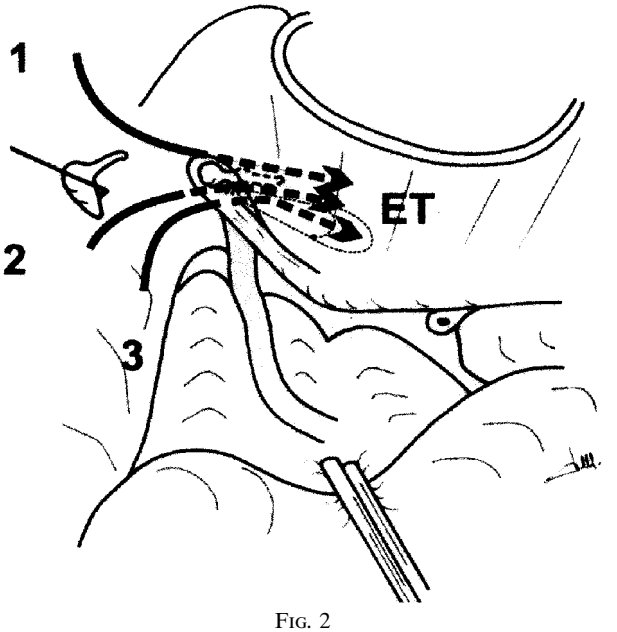

FIG. 2

Sketch diagram of right side showing removal of the incus and packing of the middle-ear cavity with periosteum. (1: pushing the periosteum lateral to the head of the malleus; 2: periosteum medial to the malleus; 3: periosteum pushed inferiorly and anteriorly towards the protympanum. ET = location of eustachian tube.

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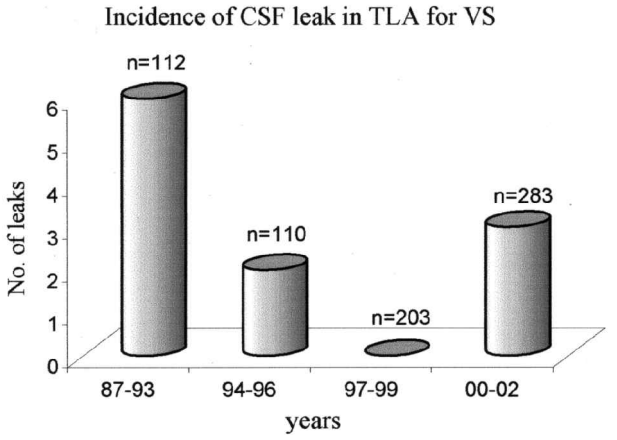

FIG. 3

Histogram showing the total number of leaks encountered during the given period. (n = total numbers of the patients operated).

Results

Out of 708 patients who underwent ETLA, 10 patients (1.41 per cent) had a post-operative CSF leak (Figure 3). Three patients were managed conservatively and seven patients required surgery to close the leak. In the last 596 cases, CSF leak was encountered in only five patients (0.84 per cent), out of whom only one (0.17 per cent) required surgical intervention.

Discussion

Cerebrospinal fluid leak following VS removal is a most challenging complication. With experience, it can be seen that anatomical factors such as the extent of pneumatization of the petrous temporal bone and posterior wall of the internal auditory canal play an important role in causing CSF leak. Saim demonstrated the presence of tubal and tympanic openings to peritubal cells which can lead to CSF leak and such cases are really difficult to manage.[17]

The principal features of our technique are: a) keeping the bone intact in the area of the facial recess, b) closing the air cells with bone wax as soon as one is encountered, c) removal of the incus and packing the aditus, attic and the middle-ear space with periosteum, d) closure of the dural defect and obliteration of the mastoid cavity with long strips (1 cm × 6 cm) of fat in a 'champagne cork' fashion and finally, e) closing the wound in three layers.

- **CSF leaks after removal of vestibular schwannomas (VS) are a challenging complication**
- **A well tried surgical technique to prevent CSF leak is described**
- **This has helped the authors achieve the lowest reported rate of post-operative CSF leak in translabyrinthine excision of VS in the world literature**

FIG. 4

Post-operative axial MRI showing presence of fat in the CP angle and mastoid.

Use of periosteum to obliterate the middle ear and aditus is supported by the fact that fat gets absorbed once it comes in contact with the air through the eustachian tube and thus increases the chances of formation of a channel between the operative site and middle ear. This was the experience in the cases which were operated before 1994. Periosteum remains in place for a much longer time.

In a few cases, a pneumatized facial recess was encountered or the facial recess was opened inadvertently which was managed by closing it with bone wax. With overzealous drilling of the vestibule, it is possible to breach the sub-facial recess (sinus tympani). This should be managed meticulously by packing it with periosteum. Placing the long fat strips needs particular attention since it is possible to encounter grave complications if the fat strips prolapse into the angle as reported by Chen *et al.*[18] However to date no such complication has occurred (Figure 4).

In a few selected cases where high resolution CT scans show a highly pneumatized petrous apex, infralabyrinthine and zygomatic compartments of the temporal bone, or in cases that require surgery following post-operative leak, we have not hesitated in closing the ear canal as a blind sac. For the last few years, straight and angled endoscopes have been employed to visualize the operative field so as not to leave any cell tract open.

Conclusion

It is recommended that every precaution should be exercised intra-operatively during the removal of VS so as to avoid any possibility of a post-operative CSF leak. Proper evaluation of high resolution computed tomography (HRCT) scans of the temporal bone pre-operatively is of utmost importance since it provides valuable information to the surgeon about the presence of air cells in key areas. Following the above mentioned technique, it was possible to achieve the lowest rate of CSF leak reported in the literature.

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References

1 Falcioni M, Mulder JJS, Taibah A, DeDonato G, Sanna M. No cerebrospinal fluid leaks in translabyrinthine vestibular schwannoma removal. *Am J Otol* 1999;**20**:660–6
2 Dandy WE. Treatment of rhinorrhea and otorrhea. *Arch Surg* 1944;**49**:75–85
3 Montgomery WW. Surgery for cerebrospinal fluid rhinorrhea and otorrhea. *Arch Otolaryngol* 1966;**84**:538–50
4 Pulec JL. Technique to avoid cerebrospinal fluid otorhinorrhea with translabyrinthine removal of acoustic neuroma. *Laryngoscope* 1994;**104**:382–6
5 House JL, Hitselberger WE, House WF. Wound closure and cerebrospinal fluid leak after translabyrinthine surgery. *Am J Otol* 1982;**4**:126–8
6 Tos M, Thomsen J. *Translabyrinthine Acoustic Neuroma Surgery*. New York: Thieme Medical Publishers, Inc., 1991.
7 Harner SG, Laws ER Jr. Translabyrinthine repair for cerebrospinal fluid otorhinorrhea. *J Neurosurg* 1982;**57**:258–61
8 Harner SG, Ebersold MJ. Management of acoustic neuromas, 1978–1983. *J Neurosurg* 1985;**63**:175–9
9 Yasargil MG, Smith RD, Gasser JC. Microsurgical approach to acoustic neurinomas. *Adv Tech Stand Neurosurg* 1977;**4**:93–103
10 Bentivoglio P, Cheeseman AD, Symon L. Surgical management of acoustic neuromas during the last five years. Part I. *Surg Neurol* 1988;**29**:197–204
11 Lebowitz RA, Hoffman RA, Roland JT Jr, Cohen NL. Autologous fibrin glue in the prevention of cerebrospinal fluid leak following acoustic neuroma surgery. *Am J Otol* 1995;**16**:172–4
12 Brennan JW, Rowed DW, Nedzelski JM, Chen JM. Cerebrospinal fluid leak after acoustic neuroma surgery: influence of tumor size and surgical approach on incidence and response to treatment. *J Neurosurg* 2001;**94**:217–23
13 Glasscock ME III, Kveton JF, Jackson CG, Levine SC, McKenna KX. A systematic approach to the surgical management of acoustic neuroma. *Laryngoscope* 1986;**96**:1088–94
14 Wiet RJ, Mamikoglu B, Hoistad D, Battista R. A technique to prevent cerebrospinal fluid leakage after translabyrinthine approach. *Laryngoscope* 2000;**110**:1234–6
15 Sanna M, Saleh E, Panizza B, Russo A, Taibah A. *Atlas of Acoustic Neurinoma Microsurgery*. Stuttgart/New York: Georg Thieme Verlag, 1998
16 Fisch U, Mattox D. *Microsurgery of the Skull Base*. New York: Thieme Publishers, Inc., 1988
17 Saim L, McKenna MJ, Nadol JB. Tubal and tympanic openings of the peritubal cells: implications for cerebrospinal fluid otorhinorrhea. *Am J Otol* 1996;**17**:335–9
18 Chen TC, Maceri DR, Levy ML, Giannotta SL. Brainstem compression secondary to adipose graft prolapse after translabyrinthine craniotomy: case report. *Neurosurg* 1994;**35**:521–4

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