

## Air travel induced meningitis following vestibular schwannoma (acoustic neuroma) surgery

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### Abstract

Two cases are presented in which patients flying home shortly after translabyrinthine removal of a vestibular schwannoma (acoustic neuroma) developed acute bacterial meningitis on landing. This complication has not been described before. The incidence and management of CSF leaks after vestibular schwannoma surgery is also discussed.

**Key words:** Vestibular schwannoma, surgery; Meningitis; Aircraft; Travel

### Introduction

Surgical removal of vestibular schwannomas (acoustic neuromas) was first undertaken successfully by Sir Charles Ballance in 1894 (Ballance, 1907). Initially mortality rates of 70–80 per cent were reported. This led to the modified surgical approach of Cushing (1917) in which the tumour was only partially excised that reduced the mortality rate to about 25 per cent, although either tumour recurrence or revision surgery led to the death of another 25 per cent of patients within five years. Dandy (1925) reintroduced the concept of complete surgical removal via the suboccipital approach to prevent tumour recurrence. The reported mortality rate was 40 per cent. House (1964) introduced the translabyrinthine approach, utilizing otomicrosurgical techniques, and reported an operative mortality rate of 5.4 per cent.

At present, the most persistently troublesome complication of the operation for the removal of vestibular schwannomas is a cerebrospinal fluid (CSF) leak whether the approach is translabyrinthine, retrosigmoid, suboccipital or middle fossa. The CSF leak usually presents in the early post-operative period. In the series reported by Bryce *et al.* (1991) the incidence of leaks following primary tumour removal via the translabyrinthine approach was 11 per cent with 47 per cent of these presenting through the Eustachian tube or external auditory meatus, four per cent were associated with meningitis and 12 per cent needed surgical closure. Other series broadly follows these trends although a post-operative leaks rate as high as 21 per cent was reported by King and Morrison (1980) (Table I).

CSF leaks after vestibular schwannoma surgery can occur through the incision, through a defect in the tympanic membrane, as otorrhoea, or via the Eustachian tube as otorhinorrhoea. The fistula is usually due to CSF entering the retrolabyrinthine mastoid air cells and then draining to the ipsilateral nostril via the middle ear and Eustachian tube (Ebersold *et al.*, 1992). Meningitis after excision of vestibular schwannomas results from aseptic inflammation or bacterial infection of the meninges.

Unfortunately, it is often difficult to distinguish between the benign sterile process and the potentially lethal infection on the basis of clinical and laboratory criteria (Bryce *et al.*, 1991). An increase in the incidence of

TABLE I  
RESULTS OF SURGERY IN SOME RECENT MAJOR SERIES

Surgical approach	Number	CSF leak (per cent)	Meningitis (per cent)
Translabyrinthine			
Bryce <i>et al.</i> (1991)	406	11	4
Glasscock <i>et al.</i> (1986)*	436	11	*
Hardy <i>et al.</i> (1989)	100	13	3
King and Morrison (1980)	150	21	4
Mangham (1988)	103	16	5
Tos <i>et al.</i> (1989)	300	11	4
Whittaker and Luetje (1985)	50	14	10
Total	2125	11	3
Suboccipital			
Bentivoglio <i>et al.</i> (1988)	94	24	6
Bryce <i>et al.</i> (1991)	152	10	3
Di Tullio <i>et al.</i> (1978)	79	13	3
Glasscock <i>et al.</i> (1986)*	24	27	*
Harner and Ebersold (1985)	162	12	5
Ebersold <i>et al.</i> (1992)	256	11	1
Mangham (1988)	42	10	0
Total	529	13	4
Middle fossa			
Gantz <i>et al.</i> (1986)	43	9	2
Glasscock <i>et al.</i> (1986)*	49	12	*
Total	92	11	2
Translabyrinthine/middle fossa combined approach			
Bryce <i>et al.</i> (1991)	82	29	7
Glasscock <i>et al.</i> (1986)*	107	25	*
Total	189	27	7

\* In this series overall meningitis rate was five per cent and in every case was associated with a CSF leak, eight per cent needed surgical closure.

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meningitis of up to five-fold has been reported in this subgroup of patients (Mangham, 1988). When removing the tumour via the translabyrinthine approach there is no correlation between tumour size and the occurrence of post-operative otorrhoea (Tos *et al.*, 1989).

Leaks are more common from the ear or nose after the suboccipital approach, whereas with the translabyrinthine approach there were more leaks from the incision (Bryce *et al.*, 1991). Tos *et al.* (1989) reported an 11 per cent CSF leak rate, re-operation was necessary in five per cent of patients in whom the leak lasted two weeks and the rate of meningitis was four per cent. Early post-operative repair at four days is recommended by Ebersold *et al.* (1992) and in their series a meningitis rate of only one per cent is documented.

The risk of post-operative meningitis is not related simply to the development of CSF leakage. The protracted nature of the operation and the communication via the Eustachian tube are two other important factors. Hardy *et al.* (1993) reported a modified wound closure method which reduced post-operative CSF leak from 13 per cent to 1.6 per cent. Unfortunately, the incidence of meningitis (not reported) was unaffected by the change in wound closure technique, despite the substantial fall in CSF leakage rate.

### Case report

We present two cases in which patients flying home shortly after translabyrinthine removal of a vestibular schwannoma developed acute bacterial meningitis on landing. This complication has not been reported in the literature. Both patients had a post-operative CSF leak which resolved prior to discharge from hospital.

#### Case 1

A 40-year-old man underwent translabyrinthine removal of a left vestibular schwannoma. Post-operatively he developed CSF rhinorrhoea which resolved spontaneously without meningitis. On landing after a flight from London to Edinburgh he complained of headache. He was admitted to hospital where he was febrile (38.5 °C) and on examination had a stiff neck. The CSF contained 2100 white cells, glucose was reduced to 1 mmol/L. Organisms were not seen. *Haemophilus influenzae* was cultured from the CSF. He was treated with parenteral chloramphenicol, benzylpenicillin and metronidazole and recovered satisfactorily.

#### Case 2

A 64-year-old man had a left parietal meningioma removed two years previously. In our unit he underwent removal of a right vestibular schwannoma, via the translabyrinthine approach. Post-operatively he developed CSF

otorrhoea which was repaired at the same time as a facial-hypoglossal neural anastomosis was fashioned. One week later he flew from London to Athens but a few minutes before landing he complained of headache which increased over the next few hours. He was admitted to hospital where he was febrile (39.5 °C) and on examination had a stiff neck. The CSF contained 425 white cells, 99 per cent polymorphonuclear leucocytes, glucose was undetectable. *Pseudomonas aeruginosa* was cultured from both the CSF and the external auditory meatus. He was treated with parenteral ceftazidime and dicloxacillin and recovered satisfactorily.

### Discussion

The tendency for patients with a vestibular schwannoma to seek treatment in specialized centres, often in foreign countries, means that air travel soon after operation is relatively common. CSF leaks are not uncommon with the posterior fossa or retrosigmoid operations but it is only likely to occur if air cells in the meatus have been opened. The anatomical basis for a leak therefore exists in only a limited number of these patients. On the other hand, the translabyrinthine operation inevitably involves opening the middle ear and putting it into communication with the cerebellopontine angle cistern. Despite careful sealing of the middle ear space with fat, bone paté, muscle or fascia, CSF leaks still occur and usually need re-operation with a further attempt to seal the communication.

The change in differential pressure (between atmospheric and the middle ear space) during air travel can affect any air containing space in the head i.e. the tympanic space and paranasal sinuses. During ascent, with a decrease in atmospheric pressure, gaseous expansion in the mesotympanum will push the tympanic membrane to the natural limit of its excursion. This is followed by the escape of air along the healthy Eustachian tube. During descent, with an increase in atmospheric pressure, there is a decrease in volume of the middle ear gas. The Eustachian tube must be opened by swallowing. If this fails or if it is delayed, the increasing differential pressure will act on the Eustachian tube to prevent it opening. Any condition which narrows the tubal lumen (oedema, increased amount or viscosity of mucus coating the mucous membrane) will by impeding the flow of gas along the tube, or by impairing the ability of the tube to open, predispose to barotrauma. The commonest predisposing causes of acute barotrauma are acute and chronic infections in the nose, particularly coryza, nasal allergy and vasomotor rhinitis and malformation of the nasal skeleton (Benson and King, 1987).

### Treatment

CSF leaks may be treated expectantly with lumbar drainage alone or in combination with surgery. Expectant treatment includes elevation of the head of the bed, suture of incisional leaks, and pressure dressings. Lumbar drainage without surgery in addition to expectant measures is sufficient treatment for a minority of patients. The majority of patients with a CSF leak require surgery and the four approaches commonly used are: (1) re-exploration of the mastoidectomy defect with repositioning of the fascia lata and fat pack, as well as repacking of the middle ear and Eustachian tube; (2) tympanotomy with temporalis muscle plugging of the Eustachian tube and middle ear; (3) radical mastoidectomy with obliteration of the external ear, middle ear and Eustachian tube; and (4) transnasopharyngeal Eustachian tube obliteration (Bryce *et al.*, 1991).

TABLE II

RATE OF SURGICAL CLOSURE (PER CENT)

Surgical approach	
Translabyrinthine	
Bryce <i>et al.</i> (1991)	12
Hardy <i>et al.</i> (1989)	10
Tos (1989)	5
Suboccipital	
Bentivoglio <i>et al.</i> (1988)	16
Ebersold <i>et al.</i> (1992)	9
Middle fossa	
Gantz <i>et al.</i> (1986)	2

### Conclusion

The relationship between air travel and the onset of symptoms in these cases suggests that alteration in the ambient atmospheric air pressure during the flight, (falling on ascent and rising again on landing), precipitated the invasion of the CSF by the micro-organisms. We may suppose that communication between the CSF and the middle ear was established earlier in the flight, when atmospheric pressure was falling and the micro-organism entered as soon as atmospheric pressure increased again, as secretions were forced from the nasopharynx into the subarachnoid space. Some caution ought therefore to be exercised when a leak has complicated a retrosigmoid operation. How long air travel should be deferred in these circumstances is uncertain.

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