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Petrous bone cholesteatoma and facial paralysis

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This paper describes a series of patients with a petrous temporal bone cholesteatoma paying particular attention to the complications and their management. Sixteen patients who underwent surgery in our department were reviewed. Topographically, the petrous bone choleasteatomas were grouped into five categories according to the classification proposed by Sanna *et al*. There were five massive labyrinthine; five infralabyrinthine; one apical; four supralabyrinthine; and one infralabyrinthine-apical. Clinically, the presenting symptom of these lesions were facial nerve paralysis (10 patients) and unilateral deafness (13 patients). Total removal of the cholesteatomas was achieved in all patients using different surgical approaches according to their site and extent. Recurrences were observed in two patients after 8 months and 24 months, respectively. The facial nerve was infiltrated and compressed by the cholesteatoma in eight patients. Seven were managed with cable grafts using sural nerve. One of these patients was treated using a facial-hypoglossal anastomosis because of the failure of the graft. In the remaining patient, a baby-sitter procedure was employed. In the other two patients, the preoperative facial paralysis was due to compression by the cholesteatoma, and its removal allowed partial recovery of facial function. The rationale of the surgical management of petrous bone cholesteatoma is its radical and total removal. Our present policy is to prefer approaches which result in a closed cavity obliterating the eustachian tube and closing the auditory canal as a blind sac. Facial nerve function is the main complication of these lesions. Facial nerve involvement requires rapid management because the duration of the paralysis is directly related to poor recovery of facial function.

Keywords *facial paralysis* *petrous bone cholesteatoma* *skull base surgery* *vertigo*

Petrous temporal bone cholesteatoma is an uncommon lesion which frequently invades the labyrinth and fallopian canal. It differs in some ways from the usual cholesteatoma, mainly in its extent and possible involvement of the jugular bulb, the internal carotid artery and the dura mater.[1–12] It usually has an acquired origin, but in some patients it may be congenital from a primary embryonic rest.

The advent of high resolution computed tomography (CT) and magnetic resonance imaging (MRI) has provided more defined and detailed preoperative information on the extent and the routes of spread of this lesion.[10] One of the most interesting aspects of the improvement of imaging is the possibility of producing an accurate classification of these lesions with specific clinical and surgical implications.

Only a few reports have been published on this specific topic.[5,9,11,12] Fisch[9] first identified two types of these cholesteatomas (supralabyrinthine and infralabyrinthine-apical) and Bartels[5] described a third type of petrous bone cholesteatoma (translabyrinthine). Glasscock[11] believes that all these cholesteatomas are apical in origin and that the involvement of other parts of the temporal bone is simply due to expansion. Recently, Sanna *et al*.[12] have proposed a more complete classification. They categorized petrous bone cholesteatoma according to their extent and clinical course and described five classes: supralabyrinthine, infralabyrinthine, massive labyrinthine, infralabyrinthine-apical and apical. Each group has specific clinical features and its own surgical approach (subtotal petrosectomy;[9,13] transotic approach;[9,14,15] transcochlear approach;[12,13,16,17] infratemporal type B or type A + B approaches;[9] transtemporal supralabyrinthine approach[9]).

The object of this study was to describe a series of 16 patients with petrous bone cholesteatomas with particular attention to the complications and management.

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Table 1. Types of surgical approach and classification of petrous bone cholesteatoma

Petrous bone cholesteatomas	A	B	C	D	E
Supralabyrinthine	2	2	–	–	–
Infralabyrinthine	–	5	–	–	–
Massive labyrinthine	–	–	4	1	–
Infralabyrinthine-apical	–	–	–	–	1
Apical	–	–	–	–	1

A = Transtemporal supralabyrinthine approach. B = Subtotal petrosectomy. C = Transotic approach. D = Transcochlear approach. E = Infratemporal type B or type A/B.

Material and methods

The case notes of 16 patients with a petrous bone cholesteatoma, who were referred for surgery between 1 January 1987 and 1 March 1995 to the Second and Fourth ENT Clinics, University 'La Sapienza', Rome, were reviewed retrospectively. This group consisted of 11 men and five women. Their mean age was 39.3 years, with a range of 22–69 years. Preoperatively, 12 patients had a chronically discharging ear. In 10 the major symptom was facial nerve paralysis. Eight of these patients had a preoperative grade V and VI paralysis according to the House-Brackmann system.[18] The remaining two patients had grade IV paralysis. The duration of preoperative facial dysfunction was 16.1 months, ranging from 3 to 37 months.

Only three patients had normal hearing. The distribution of hearing impairment identified six patients with total deafness, three patients with mixed hearing loss, three with conductive hearing loss and one with sensorineural loss.

Other preoperative symptoms were headache (one patient), tinitus (three) and vertigo (seven).

Otoscopic examination revealed three normal tympanic membranes, four epitympanic perforations and four subtotal or total perforations. The other five patients had a history of previous surgery (three radical mastoidectomy and two closed tympanoplasty).

Topographically the petrous bone cholesteatomas of the present series were grouped using Sanna's classification and different surgical approaches were used (Table 1). The patients were followed-up using high resolution CT and/or MRI (Figures 1–4). The duration of the follow-up was on average 22.3 months, ranging from 12 to 60 months.

Results

Total removal of the petrous bone cholesteatoma was achieved in all patients. Recurrences were identified in two patients after 8 months and 24 months. These patients were primarily operated on using open techniques (radical petromastoidectomy) with the occurrence of skin entrapment. They were revised and the cavity was excluded from the external environment employing abdominal fat combined with blind sac closure of the external auditory canal and obliteration of the eustachian tube.

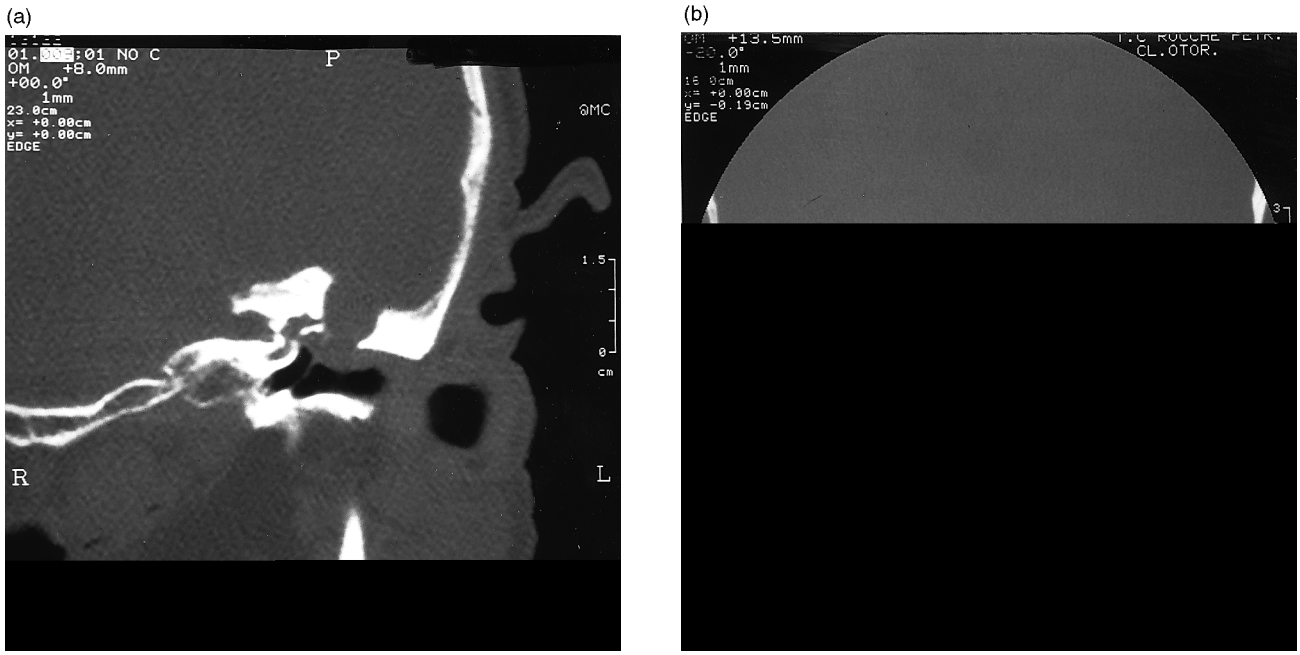

Figure 1. (a) Preoperative CT coronal view of petrous bone cholesteatoma. (b) Postoperative coronal view (translabyrinthine approach).

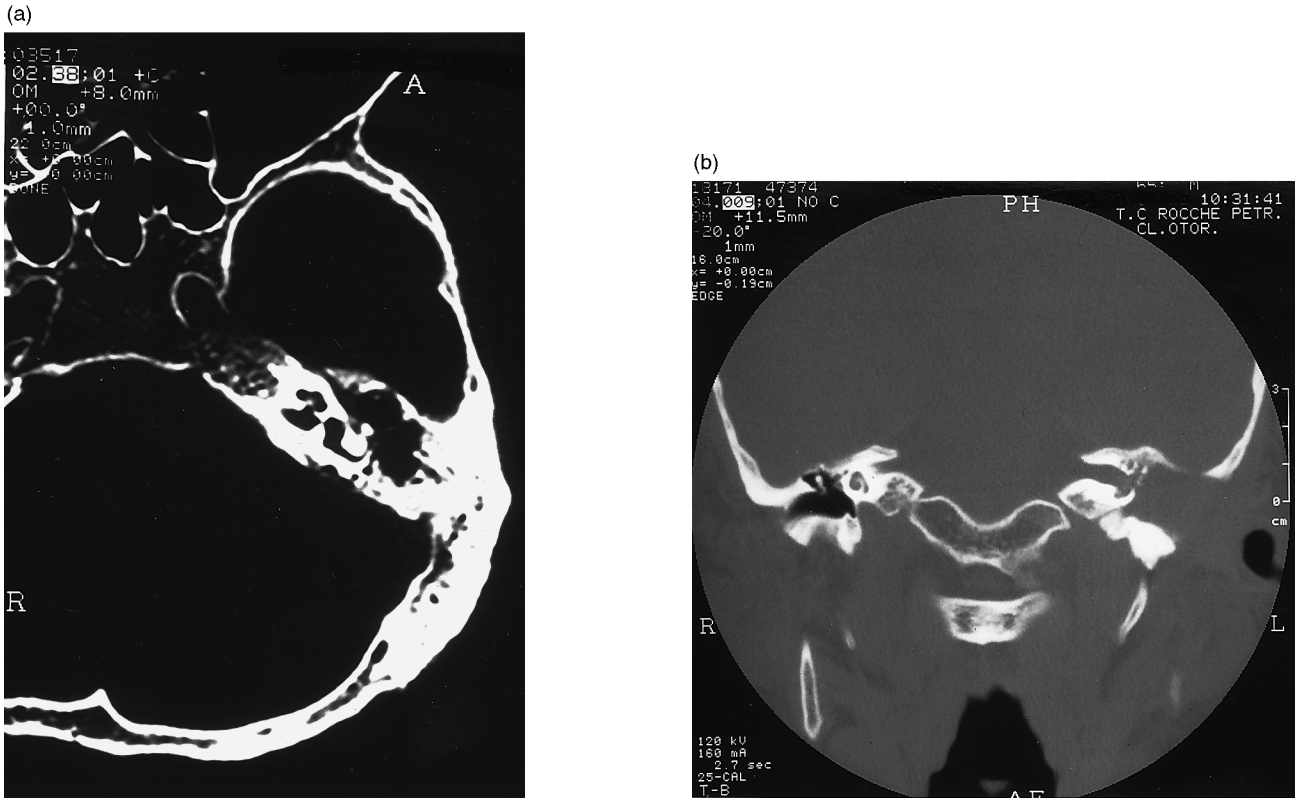

Figure 2. (a) Preoperative axial view of petrous bone cholesteatoma. (b) Postoperative coronal view (translabyrinthine approach).

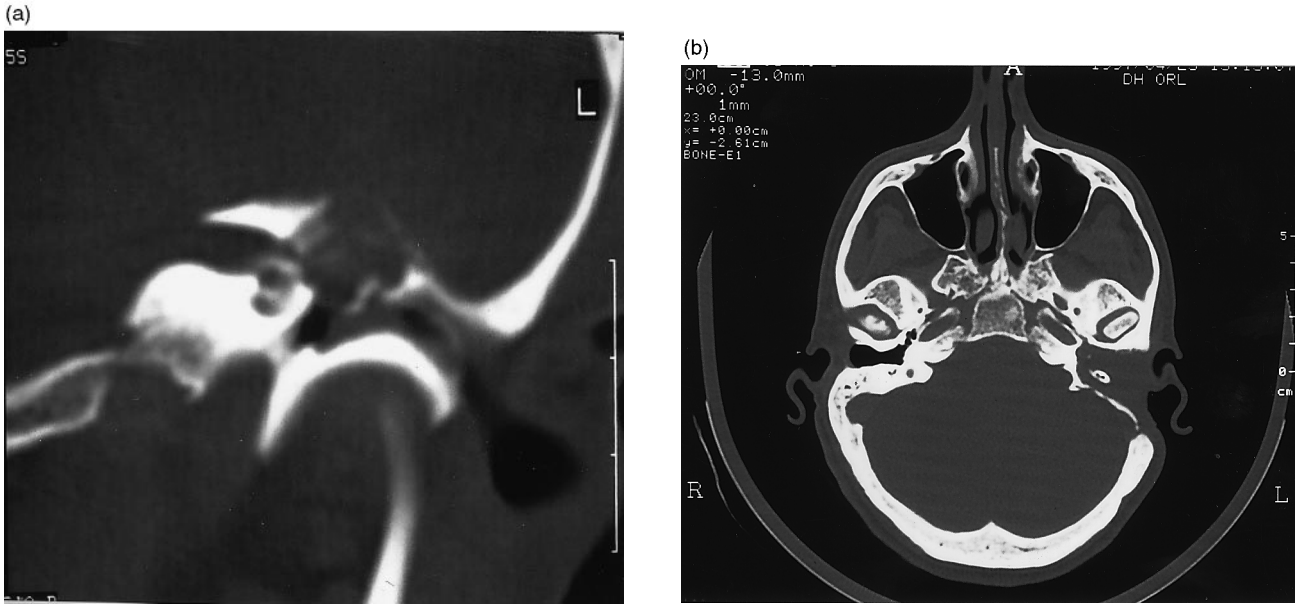

Figure 3. (a) Preoperative coronal view of petrous bone cholesteatoma. (b) Postoperative axial view (transotic approach).

The postoperative hearing with pure air-tone averages in the frequency range of 250–8000 Hz is shown in Table 2. The data showed an increase in the patients with total deafness and a marked reduction in the patients with normal hearing.

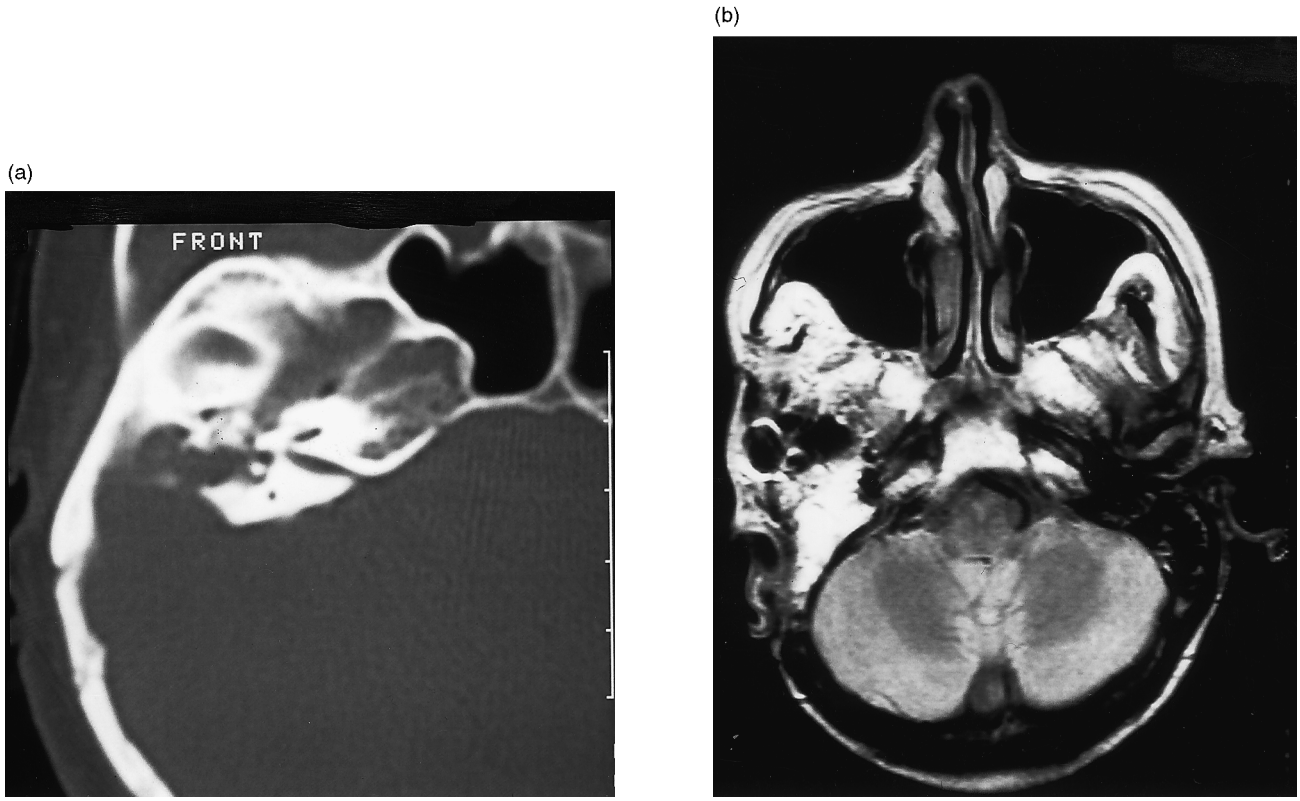

Figure 4. (a) Preoperative CT axial view of petrous bone cholesteatoma. (b) Axial view of postoperative MRI (transcochlear approach).

Table 2. Preoperative and postoperative hearing with pure air-tone averages

	Preoperative hearing*	Postoperative hearing*
Normal	3 (13.3 dB)	1 (10 dB)
Conductive hearing loss	3 (38.3 dB)	3 (42.8 dB)
Mixed hearing loss	3 (45.6 dB)	2 (44.7 dB)
Sensorineural hearing loss	1 (66.3 dB)	1 (72.3 dB)
Dead ear	6 (–)	9 (–)

* Number of patients (pure air-tone average).

The facial nerve was infiltrated and compressed by the cholesteatoma in eight patients. Seven were managed with cable grafts using the sural nerve. One of these patients was treated using a facial-hypoglossal anastomosis due to failure of the previous graft. In the remaining patient a baby sitter procedure[19] was preferred because the preoperative facial palsy was present for more than 3 years. This latter utilizes 30% of XII, or XI, or V cranial nerves anastomozed with the main trunk of the facial nerve in order to maintain adequate bulk of the facial musculature. At the same time the first stage of cross-facial interposition sural nerve grafts (usually three) is performed for coaptation of selected facial nerve branches of the normal side.

After 9 months, the second stage is performed coupling the cross-facial grafts with the peripheral branches of the paralysed facial nerve.

In the other two patients the preoperative facial paralysis was due to compression by the cholesteatoma and its removal provided partial recovery of facial function. The findings of postoperative facial function are listed in Table 3.

Intraoperatively, two patients had involvement of the vertical and/or horizontal portion of the internal carotid artery. In two patients the close adherence of the cholesteatoma to the sigmoid sinus and to the jugular bulb was managed by ligation and excision of the sinus and jugular vein and with packing of the inferior petrosal sinus. Cerebrospinal fluid leakage occurred subcutaneously in three patients. This resolved with pressure dressing in two patients, while the other was treated using a lumbar drain for 7 days. Wound infection occurred in one patient.

Discussion

Petrous bone cholesteatomas present a diagnostic and therapeutic challenge for the surgeon. They have an aggressive

Table 3. Postoperative facial function and surgical treatment of facial paralysis

	Sural nerve grafts	Rerouting	VII–XII anastomosis	Baby sitter
House–Brackmann				
Grades I–II	–	1	–	–
Grades III–IV	4	1	1	1
Grades V–VI	2	–	–	–

nature with frequent and concomitant complications.[1–9,11,12,20] Bartels,[5] reviewing the English literature, reported that 37 of 80 patients presented with facial nerve disturbances. This was substantiated by Sanna *et al*.[12] with an incidence of 42.5% of altered facial function, and by Chung Hua *et al*.[8] who observed such dysfunction in six of their seven patients.

In our present study, 62.5% of the patients showed disturbed facial function. This incidence is considerably higher than that reported elsewhere. This difference may be related to the possible selection of the patients, particularly since some of our patients were referred to us by other specialists. Various degrees and types of hearing loss were detected in our patients. In other series[5] the percentage of significant hearing loss prior to operation has varied from 50% to 65%. Analysis of our patients gave a similar figure (81% deafness before surgery). In the literature review, hearing was maintained postoperatively only in 34% of patients.[5] Our experience confirms these findings testifying to the difficulties of preserving hearing in this disease especially when the otic capsule is extensively eroded. This observation has significant implications for the choice of the surgical approach for petrous bone cholesteatomas.

There is general agreement favouring the radical removal of the cholesteatoma using a subtotal petrosectomy with sacrifice of the otic capsule and obliteration of the cavity.[9,10,12,14–16] Obviously, this treatment plan is indicated when the contralateral hearing is unaffected. This rationale of management does not apply to petrous bone cholesteatoma in an only hearing ear. This situation forces one to preserve the hearing using a more conservative surgical procedure over complete disease removal. Glasscock *et al*.,[21] Fisch[9] and Sanna *et al*.[12] recommend a widely exteriorized temporal bone cavity. Wide exteriorization of the disease precludes a radical removal of pathological tissue, but it allows hearing preservation, avoiding damage to the inner ear. In these patients regular follow-up is mandatory and every effort should be made to prevent infections (suppurative labyrinthitis, meningitis or brain abscess). The development of these needs rapid treatment and, thus, it is important to educate the patient to seek medical advice early.

The goal of hearing preservation and radical cholesteatoma removal is only possible in selected supralabyrinthine cholesteatomas with no cochlear or labyrinthine involvement.[12,22]

From the lateral skull base techniques, all segments of the facial nerve can be exposed. There are many surgical options linked to the types (compression, interruption or fibrous replacement) and the extent of nerve involvement. Simple decompression in two of our patients gave an excellent result when the facial nerve was anatomically intact. A facial nerve deficit secondary to disruption or fibrous replacement can be repaired using various surgical techniques. These include nerve to nerve anastomosis after rerouting, nerve grafting, hypoglossal facial anastomosis and the baby sitter procedure.

Our six preoperative facial palsies present for less than 2 years were treated with sural nerve grafts. They gave good functional results in three patients, fair outcomes in two other patients and no improvement in the other patient who was finally treated with a hypoglossal-facial anastomosis. Hypoglossal-facial nerve anastomosis is performed to restore function when the facial paralysis dates for more than 2 years.[12] There are similar indications for the baby sitter technique.[19] It allows neural reanimation with synchronous facial movements (i.e. more natural smile, less synkinesis). The baby sitter procedure is a valid alternative to XII–VII anastomosis and it is our method of choice in selected patients with this particular type of facial paralysis.

The lateral skull base approaches to these lesions with exclusion of the cavity to the external environment have other advantages, e.g. they allow one to handle the vital structures (carotid artery, sigmoid sinus, jugular bulb and dura) more easily. There is no doubt that the obliteration reduces infection and CSF leaks. This is particularly true when there is dural involvement. In these patients, regular follow-up with CT scans or MRI techniques is essential because of the potential risk of cholesteatoma recurrences.

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