Computed Tomography of the Internal Auditory Canals

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INTRODUCTION

The assessment of lesions involving the internal auditory canals and cerebellopontine angle has come to rely heavily on computed tomography (CT). The resolution of modern CT scanners is now comparable to that of complex movement conventional tomography, and CT has the advantage of demonstrating the soft tissue lesion and its intracranial extent, as well as any abnormality of the bone.

The most common reason for radiography and CT scanning of this region is to look for an acoustic neurinoma in patients with sensineural hearing loss. Radiographs of the internal auditory canals should be requested before moving on to CT, since it is unusual to find an abnormality on CT if plain films are normal. Films are normally requested only when there is audiological evidence of sensineural hearing loss.

PLAIN RADIOGRAPHY

The normal series of films for the internal auditory canals consists of postero-frontal and fronto-occipital (Townes) views, both with a silt diaphragm. These allow simultaneous comparison of both petrous temporal bones. Oblique views (modified Stenvers) are also taken of each petrous temporal bone. These views demonstrate any enlargement or erosion of the internal auditory canal on the affected side. The margins of the internal auditory canal can be seen more clearly using conventional tomography. Complex movement tomography is used, usually hypocycloidal, in order to obtain thin cuts, of the order of 1-2mm, and to abolish linear artefacts. The auditory ossicles are also better seen. However, all these structures are clearly seen on CT, which also demonstrates the soft tissues, so that if an abnormality is demonstrated on plain films CT is the next recommended radiological investigation, if it is available.

COMPUTED TOMOGRAPHY

As the majority of CT scans of the petrous temporal bone are performed for the investigation of a possible acoustic neurinoma, which enhance strongly with intravenous contrast medium, it is the usual practice to scan after the administration of contrast medium. A non-ionic preparation such as iohexol 350mg iodine/ml or iopamidol 370mg iodine/ml is suitable. A 50ml bolus is given intravenously, 3 to 5 minutes before the scan. Some authors prefer a continuous infusion started five minutes before the scan is commenced (3). It takes several minutes for contrast medium to accumulate in a tumour, but it may remain there for several hours. Therefore a bolus injection is satisfactory when a tumour is suspected, but an infusion is preferable to demonstrate vascular abnormalities (2).

The Bristol Royal Infirmary is equipped with a Siemens Somatom DRH scanner. When scanning the petrous temporal bone, it operates at 125kV and 550mAs. The scan time is 7 seconds and the slice thickness is 2mm. The patient is moved 2mm after each section. Images are taken using both soft tissue and bone window settings, of the same slice. The slices are made in the axial plane, parallel to the anthropological baseline, which extends from the inferior orbital margin through the external auditory meatus. This line is chosen because it avoids direct irradiation of the eyes (13). Scans through the temporal bone are usually sufficient, but the examination is extended to include the entire cranium when indicated.

In normal studies, the CT scan, at bone settings, shows the shape and size of the internal auditory canal and meatus, while at soft tissue settings it demonstrates CSF in the internal auditory canal, as the subarachnoid space follows the VIIth and VIIIth cranial nerves (Figure 1). Several tributaries of the petrosal vein converge just behind the posterior margin of the internal auditory meatus. In studies using an infusion of contrast medium, this may result in a small area of enhancement at this site (3). This blush is much less likely to be seen following a bolus injection, as the scans are performed well after the peak plasma concentration of contrast medium has passed.

If an unenhanced scan is performed at bone settings the only sign of a tumour may be enlargement and erosion of the internal auditory meatus (Figure 2).

Scanning after IV contrast medium will show tumours extending for 1cm or more into the cerebellopontine angle. This accounts for some 90% of tumours. However, smaller lesions may not be shown, so in patients with a strong clinical indication of VIIth nerve compression and a normal CT scan, air metaitography may show smaller and intracanalicular tumours.

AIR MEATOGRAPHY

After 4–5 mls of air are injected into the subarachnoid...
between adjacent bone and soft tissue in this region. Secondly, the inferior margin of the internal meatus may be partially included in the scan, overlapping the subarachnoid space. This may give the impression of an enhancing lesion in the cerebellopontine angle (3).

### Differential Diagnoses

1. **Acoustic neurinomas:** These comprise almost 80% of all mass lesions in the cerebellopontine angle (14). The characteristic appearance is of a strongly enhancing lesion, which arises in the internal auditory canal, and erodes the surrounding bone (Figures 4 and 5). The vast majority of acoustic neurinomas enhance (5, 7), whilst when unenhanced nearly 60% are isodense with normal brain tissue (7, 12). Occasionally, localised areas within the tumour do not enhance, but a predominantly non-enhancing acoustic neurinoma is very rare. Bilateral acoustic neurinomas are suggestive of neurofibromatosis (7).

2. **Other lesions**—Several other lesions occur in the cerebellopontine angle, but these are all relatively rare (11).

### Possible Artefacts

There are two particular causes of artefact in the posterior fossa. Firstly, linear or 'streak' artefacts are common. These are due to the large difference in attenuation space by lumbar puncture, the patient can be positioned so that the air passes into the cerebellopontine angle and internal auditory canal of the uppermost side. The technique was described by Isherwood, 1972 (6) for use with conventional tomography, but it is even more sensitive when combined with CT (1, 3). The scan is performed in the lateral position, and both sides can be studied in turn with a single injection of air.

With this technique, the facial and vestibulocochlear nerves can be traced from the brainstem to the apex of the internal auditory canal (Figure 3). The anterior inferior cerebellar artery can sometimes be seen looping close to, or even into, the meatus. A possible source of error can occur if a small amount of CSF is trapped at the apex of the canal by air. This gives an area of CSF density at the apex, which may be mistaken for a small neuromma. The scans must be repeated after a radiologist has tapped the patient's head in an attempt to dislodge the CSF.
a. Meningiomas:—These will also enhance after IV contrast medium. They rarely arise in the internal canal, and tend to make an obtuse, rather than acute, angle with the temporal bone. Calcification may be present on the pre-contrast scan and there may be hyperostosis of the temporal bone (3).

b. Facial neurinomas:—These are indistinguishable from acoustic neurinomas when they arise in the internal canal.

c. Trigeminal neurinomas:—These usually arise above the apex of the petrous temporal bone.

d. Epidermoid (Primary cholesteatomas):—The attenuation is close to that of CSF and they do not enhance. The mass effect is important in diagnosis, and air metatography will define the extent.

e. Aneurysms:—Aneurysms of the basilar and anterior inferior cerebellar arteries occur in this region. These will enhance using dynamic CT with an IV infusion of contrast medium.

A few other lesions occur at this site, but they are excessively rare. They include dermoids, plasmacytomas, chordomas and solitary metastasis.

There is resurgence of interest in a theory that tic dolorose and trigeminal neuralgia may be caused by vascular loops coming into contact with the affected nerve. This was first described by Dandy in 1934 (4), and also more recently by other authors (8). Vertebral angiography has been used to demonstrate this (10), and it is feasible that dynamic CT may provide a less invasive alternative method of investigation.

SUMMARY

CT of the internal auditory canal can now approach the resolution of hypocycloidal tomography, and has the advantage that it will image soft tissue components and intracranial extent.

Small lesions of the internal auditory canal may be demonstrated with air metatography.

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The Bristol Medico-Chirurgical Society

The Society invites doctors in the Bristol area to join, and reminds existing members of the need for regular recruitment and asks them to invite colleagues who they think would enjoy membership.

The society was founded in 1874 with fifty members. Regular meetings have been held ever since without interruption by two world wars. Initially, as now, papers were given, there were discussions on chosen themes and case presentations. From its inception the society has been a ‘club’ at which doctors from Bristol and the surrounding area could meet together, it formed a bond between doctors in general practice, hospital doctors, doctors in the public services and others. This is still the most important function of the society. In the early days it was perhaps the main source of postgraduate education, nowadays there are meetings, conferences and courses on all subjects aplenty and the Postgraduate Centres are a constant source of further education. Accordingly meetings of the society are designed less to educate than to interest, and speakers well known in other fields are invited. The social aspect is enhanced by a buffet supper. Most of the meetings are held in the postgraduate centres, but there are also visits with clinical meetings at local hospitals or to local places of interest. New members are usually recruited by existing members, but any doctor wishing to join who does not know who to approach should write to the Hon. Secretary, Mr Roger Baird, 23 Old Sneed Park, Bristol BS9 1RG who will be glad to find a proposer. The society is particularly glad to welcome young members.