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Main Article

Magnetic resonance imaging scans for vestibulocochlear nerve tumours: what is actually found?

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Abstract

Background: Approximately 20 per cent of adult patients presenting to otolaryngology clinics have symptoms pertaining to the inner ear. These are investigated with magnetic resonance imaging (MRI) internal auditory meatus scans. This study analysed all findings from 736 sequential MRI internal auditory meatus scans performed on 731 patients over a one year period.

Methods: Six hundred and seventy-two patients were included for analysis. Of these, 419 (62.35 per cent) had normal MRI scans, 221 (32.90 per cent) had MRI findings thought to be unrelated to their presenting symptoms, 32 (4.76 per cent) had findings thought to be the cause of their symptoms, and eight (1.19 per cent) had the typical appearance of an VIIIth nerve schwannoma.

Conclusions: Magnetic resonance image scanning of the inner ears and auditory pathways yields a diagnosis of VIIIth nerve tumours of the order of 1 per cent, does not show other causes of inner-ear symptoms in a further 4 per cent, and shows incidental intra- and extracranial abnormalities in a further 33 per cent, most of which are not clinically significant.

Key words: Magnetic Resonance Imaging; Internal Auditory Meatus; Acoustic Neuroma; Incidence

Introduction

We studied the prevalence of all pathology, clinically significant or not, detected by magnetic resonance imaging (MRI) of the inner ear and brain in adult patients presenting to otolaryngology clinics. Cerebellopontine angle lesions are a potential cause in 19.7 per cent of adult patients presenting to otolaryngology clinics.[1] The most common treatable pathology is schwannoma of the VIIIth (vestibulocochlear) cranial nerve (also know as an acoustic neurinoma). This condition accounts for 6 per cent of intracranial tumours and has an annual incidence of between 1 in 50 000[1] and 1 in 100 000.[2] This reported incidence is increasing.[3] The clinical presentation of these tumours and other retro-cochlear pathology is notoriously varied. Magnetic resonance imaging is accepted as the 'gold standard' investigation with which to detect such pathology.[4,5]

There have been numerous retrospective studies of the case notes of patients with VIIIth nerve schwannoma shown on MRI, attempting to define the clinical and audiological factors which make tumour more likely and which therefore could influence the justification and urgency of MRI scanning. The most sensitive predictive factor seems to be interaural difference in sensorineural hearing thresholds.[6] Unfortunately, this has a low specificity. For instance, in one retrospective study, 13.5 per cent (21 out 155 cases) of VIIIth nerve schwannoma patients had normal pure tone audiograms at initial consultation.[7]

Most inner-ear MRI scans do not show the pathology causing the patients' symptoms. A small proportion show alternative causative pathology other than VIIIth nerve tumour, and a greater proportion demonstrate incidental pathology, usually but not always insignificant.

Materials and methods

We retrospectively reviewed reports of all sequential MRI scans of the inner ear and internal auditory meatus from a one year period at a large tertiary referral centre. The MRI scans had been performed on patients attending ENT clinics, at the discretion of the clinician.

All scans had been originally reported by one of two specialist ENT radiologists. The scans had been performed on Philips Gyroscan™ 1.5 Tesla and Intera™ 1.0 Tesla scanners (Philips Medical Systems, DA Best, Netherlands), using a single axial T2-weighted turbo spin echo (factor 56) sequence, with 26 over-contiguous 0.7 mm increment slices (TE (time to echo) 250 msec, TR (time to repetition) 4000 msec).

In 244 cases, MRI of the brain had also been obtained, mainly to exclude intracranial causes of

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dizziness, vertigo or tinnitus. This had consisted of at least a single axial T2-weighted scan, occasionally supplemented by axial fluid-attenuated inversion recovery and/or coronal T1-weighted scans.

In cases in which significant pathology had been reported, the subjects' case notes were also analysed to determine if the features found on the MRI scans were related to the subjects' symptoms. Repeat and post-surgical scans were excluded from the study, as were scans on patients with congenital deafness.

Results and analysis

A total of 736 scans of the inner ears had been performed on 731 patients (five had had a repeat scan within the year studied). These are summarized in Figure 1. Of these, 244 patients had also undergone brain scanning.

Thirty-six scans were excluded as they were repeat scans on patients with previously identified pathology. A further 28 scans excluded were of patients with congenital deafness; 14 of these were abnormal.

Normal scans

Of the 672 included patients, 419 (62.35 per cent) had had normal scans.

Scans showing pathology as likely cause of symptoms

Thirty-two (4.76 per cent) patients had scan findings which could reasonably be considered as the cause of their symptoms. These are summarized in Table I. Fourteen (43 per cent) patients had obliterative changes of varying degrees in the cochlea and/or vestibular apparatus, manifest as focal or diffuse loss of signal on T2-weighted MRI in the labyrinthine lumen. This may be secondary to otogenic or meningitic infection, or a sequel to trauma, otosclerosis or autoimmune disease.

Seven patients had a newly diagnosed VIIIth nerve schwannoma, and one had a diagnosis of intracochlear schwannoma on the opposite side to the subject's symptoms. Their ages ranged from 50 to 76 years. There was one case of VIIIth nerve tumours in a patient previously diagnosed as having neurofibromatosis type two.

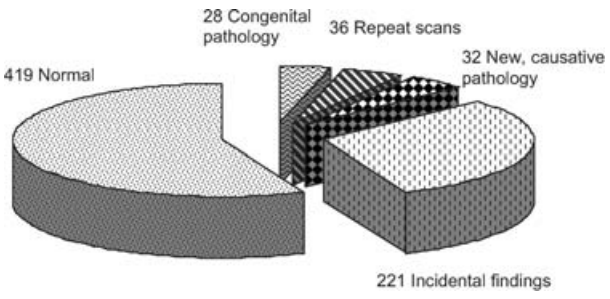

FIG. 1

Summary of reports for the 736 internal auditory meatus magnetic resonance imaging scans.

TABLE I

NEW IAM MRI FINDINGS THOUGHT TO CAUSE PATIENTS' SYMPTOMS

Pathology	*n* (%*)
VIII nerve schwannoma	7 (1.04)
– Intracanalicular	6
– Intracochlear	1
Other tumours	2 (0.30)
– Geniculate ganglion meningioma	1
– Glomus jugulare	1
Dilation of endolymphatic sac	7 (1.04)
Obliterative changes in cochlea or labyrinth	14 (2.08)
Other	
– Otosclerosis	1
– Haemorrhagic contusion in brain stem (auditory pathway)	1
Total	32 (4.76)

*Prevalence. IAM = internal auditory meatus; MRI = magnetic resonance imaging

Scans showing incidental pathology

Two hundred and twenty-one (32.90 per cent) patients had MRI abnormalities thought to be unrelated to their presenting symptoms. These are summarized in Table II. Fifteen scans showed more than one pathology. One case of VIIIth nerve tumour is included here as it was on the opposite side to the patient's symptoms.

Excluded scans

Twenty-eight scans investigating congenital or prelingual deafness were excluded.

Thirty-six of the excluded scans were repeat images to follow up previously diagnosed inner-ear pathology; nine of these were post-surgical and five were follow-up scans within the one year study period.

Of the nine post-surgical patients, no evidence of recurrence was seen in the scans of all six patients felt by the surgical team to have completely excised tumours (follow-up time was between nine and 41 months). One patient had multiple neurofibromatosis type two. Three patients had VIIIth nerve debulking procedures; of these, one had not re-grown after 12 months, one had grown 1 mm in its maximal dimension over 18 months, and one had increased by 3 mm diameter in the 12 months following surgery.

Discussion

Magnetic resonance imaging scans of the inner ears are very frequently requested by otolaryngology clinics, often constituting a heavy workload for hard-pressed imaging services. Moreover, the resolution and accuracy of scans have improved, as has their availability. This, together with the lowering of the clinical threshold for requesting such scans, has led to an ever-increasing number of patients being scanned. As a result, detection rates for serious pathology have decreased, with many more incidental findings. Most of these are not of clinical significance and include pathology such as cerebral involution,

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TABLE II

IAM MRI FINDINGS OF PREVIOUSLY KNOWN PATHOLOGY OR OBSERVATIONS CONSIDERED INCIDENTAL TO PATIENTS' PRESENTING COMPLAINT

Finding	*n* (%*)
Focal ischaemia/small vessel disease	74 (11.01)
Cerebral involution	15 (2.23)
Old haemorrhage	8 (1.19)
Coup and contre coup contusion	1 (0.15)
Focal atrophy (known old head injury)	3 (0.45)
Mastoid or middle-ear disease	38 (5.65)
Otospongiosis (otosclerosis)	1 (0.15)
Vestibular schwannoma (contralateral side)	1 (0.15)
Geniculate ganglion meningioma (contralateral side)	1 (0.15)
Paranasal sinus disease	42 (6.30)
Cysts	16 (2.19)
Pineal	2
Arachnoid	10
Dorsum sellae (congenital)	1
Occipital lobe (developmental)	1
Thornwaldt cyst of nasopharynx	1
Nasopalatine developmental cyst	1
Vascular	6 (0.90)
Cavernous angioma	2
Haemangioma at base of sphenoid	1
Venous angioma (cerebellar hemisphere)	1
Bony anomalies	3 (0.45)
Congenital block vertebrae	1
Bone spur at anterior margin of porus acousticus (contralateral side)	1
Benign lesion, angle of mandible	1
Other	12 (1.72)
Encephalomalacia	2
Parotid mass	3
Hypoplastic pituitary	1
Buphthalmos (bilateral)	1
Trigeminal and optic nerve enhancement	1
CSF leak into tympanic cavity (previously known)	1
Enlarged retropharyngeal lymph node	1
Multiple sclerosis	1
Hydrocephalus	1
Total	221 (32.90)

*Prevalence. IAM = internal auditory meatus; MRI = magnetic resonance imaging; CSF = cerebrospinal fluid

unexpected (silent) cerebral infarcts, small vessel disease, minor inflammatory sinus disease, intracranial cysts, angiomas, benign bone lesions and anatomic variants.

In our series, nine patients with tortuous vertebral arteries touching the VIIIth the nerve and three patients with prominent anterior inferior cerebellar artery loops had been classified as normal. There is debate as to how frequently these conditions cause vestibulocochlear symptoms.[8–10] Cadaveric studies showed the prevalence of anterior inferior cerebellar artery loops entering the internal auditory meatus to be around 25 per cent.[11,12] A similar prevalence can now be seen on high resolution MRI scans. Hence, many such loops had not been mentioned in the MRI reports reviewed as they formed part of the spectrum of normal anatomy.

Other (far rarer) abnormalities may be incidental to the presenting symptom but are nevertheless highly significant to the patient. In this series, such abnormalities included contralateral VIIIth nerve tumour, parotid tumours, multiple sclerosis and hydrocephalus.

Even when scanning is restricted to the inner ears rather than including the whole brain, we have detected incidental but highly significant pathology merely on the single slice localizer images, including large meningioma, olfactory neuroblastoma and pituitary adenomas.

Of the 672 scans analysed, we found a total of 253 (37.65 per cent) had some abnormality. This is comparable to the only other published series, by Schick *et al*., in which abnormalities were found in 34.5 per cent of 354 scans.[13] That series did not make any correlation between scan abnormalities and patients' symptoms. Most of our group of 221 (32.90 per cent) abnormal scans were considered incidental and clinically insignificant – only a few of these findings were clinically important. In this series, only 4.76 per cent (32 patients) had MRI findings thought to be the cause of their symptoms. The prevalence of VIIIth nerve tumours detected was comparable to that seen in other series,[4] at 1.19 per cent (i.e. 119 per 10 000). On this basis, patients can generally be reassured that it is unlikely that their scans will show any serious abnormality, even though, occasionally, other significant abnormalities, unrelated to their symptoms, are found by chance.

- **Magnetic resonance imaging (MRI) scanning of the internal auditory meatus is considered the 'gold standard' investigation for inner-ear symptoms. This study analysed 736 sequential internal auditory meatus MRI reports**
- **4.76 per cent of subjects in this study had abnormal MRI internal auditory meatus findings responsible for inner-ear symptoms, and eight (1.19 per cent) had an acoustic neurinoma. Of these eight, one was on the contralateral side to the subject's symptoms**
- **32.90 per cent of subjects had MRI findings which were either already known pathology or incidental to the presenting complaint**

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