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Finding more than what you are looking for: a retrospective study of incidental findings in magnetic resonance imaging (MRI) scans performed for patients suspicious of vestibular schwannoma

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Abstract

Background: Nearly 20% of the patients presenting to ENT department with audiovestibular symptoms are considered potential candidates for vestibular schwannoma screening. MRI scan done on these patients can also detect a large number of incidental findings. We did a retrospective descriptive study of incidental findings identified on MRI scans done on patients presenting to the ENT department in a county hospital in United Kingdom from April 2020 to April 2021. All MRI reports were scrutinised and various incidental findings tabulated. The further management of patients with these findings were also analysed.

Results: A total of 159 MRIs were reviewed. The most common incidental finding was small vessel disease followed by old infarcts. Fifteen patients were found to have significant incidental findings. The detection rate of vestibular schwannoma was 3.1%.

Conclusion: With the increased use of imaging technology, the incidence of incidental findings has risen. Understanding the significance of these findings is important so that clinicians can counsel their patients and make appropriate management plans. Categorising the incidental findings into groups based on their level of significance may help in making these clinical decisions.

Keywords: Vestibular schwannoma, Magnetic resonance imaging, Sensorineural hearing loss, Tinnitus, Incidental findings

Background

Vestibular schwannomas are benign, slow growing neoplasms of the nerve sheath which account for 6–8% of all intracranial tumours and 80% of cerebellopontine angle (CPA) tumours [1]. They may present with a variety of clinical features due to compression of the vestibular nerve, adjacent cranial nerves, brain stem, or posterior fossa structures. The commonest presenting features are unilateral sensorineural hearing loss (94%) and tinnitus (83%). The frequency of the vestibular symptoms such as vertigo and unsteadiness varies widely (17–75% of patients). Large tumours may cause trigeminal and facial neuropathies as well as brainstem compression and hydrocephalus [2]. Due to the variability of symptoms, there is an increase in the use of imaging technology to diagnose vestibular schwannomas. This has resulted in an increased detection rate of incidental findings due to the higher resolution with which these images are currently obtained. Although these findings are not accompanied

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by overt symptoms and are rarely of clinical significance, some may require further clinical evaluation and/or treatment, which may cause further anxiety to the patient and increased use of resources.

The aim of our study was to identify the various incidental findings on MRI brain performed to evaluate patients with suspicious of vestibular schwannoma.

Methods

Ethical consideration

Ethical approval was not obtained as the use of MRI is considered an integral part of diagnosis and management of these patients.

This was a retrospective descriptive study analysing MRI scans performed on patients who presented to the ENT outpatient department at a county hospital between April 2020 and 2021. Patients presenting with persistent unilateral tinnitus, asymmetric sensorineural hearing loss, or other features suspicious of CPA tumours such as impaired facial sensation and in certain patients with imbalance, which cannot otherwise be explained, underwent the MRI scan. A thorough clinical ENT examination was performed, which included a pure tone audiogram, tympanogram, and clinical vestibular testing. No electrophysiological and vestibular studies were performed at this stage. For this study, asymmetric hearing loss of 15 dB or more at any 2 adjacent test frequencies, using test frequencies of 0.5, 1, 2, 4, and 8 kHz on pure tone audiometry, was considered [3].

The exclusion criteria included the following: surveillance scan for known vestibular schwannoma, neurofibromatosis, previous surgery for cholesteatoma, congenital hearing loss, and claustrophobic patients who were unable to complete the examination.

A total of 173 scans were evaluated, of which 14 patients were excluded as they were on surveillance following previously detected CPA tumour. The final sample size was 159. The study group consisted of 94 males and 65 females, between the age group of 14 and 88. The average age group of our study population was 60.7 years.

All studies were performed on 1.5 T MR system (Phillips Ingenia). Standard MRI brain sequences including diffusion weighted images were obtained through the whole brain. Balanced steady-state gradient echo (bFFE) with CLEAR (constant level appearance) was obtained through posterior fossa for high-resolution images of the internal acoustic meatus (IAM). Gadolinium contrast (Dotarem) was used in some of the patients. The scans were reported by consultant radiologists with experience ranging from 5 to 30 years post qualification.

We categorised our MRI reports into 4 groups: (1) normal, (2) incidental anatomical variant, (3) incidental finding not clinically significant, and (4) incidental finding clinically significant.

Table 1 Categorising MRI reports based on level of significance

MRI scans	Percentage
Normal	**27.2**
Incidental anatomical variant	**9.4**
Incidental finding not clinically significant	**54**
Incidental finding clinically significant	**9.4**

Fig. 1 T2-weighted MRI image of the IAM axial section showing a right vestibular schwannoma

Results

Forty-three scans (27.2%) were reported to be normal. Non-significant anatomical variants were seen in 15 scans (9.4%). Non-significant incidental findings including diseases in mastoid and sinuses as well as small vessel diseases were seen in 86 scans (54%). Significant incidental findings were seen in 15 (9.4%) scans (Table 1).

Vestibular schwannoma was found in 3.1% patients (5 patients). Two of the patients with vestibular schwannoma presented with asymmetric hearing loss alone, 2 presented with asymmetric hearing loss along with tinnitus, and 1 presented with sudden onset sensorineural hearing loss. The patients with vestibular schwannoma < 2 cm were kept on surveillance at our hospital.

Larger vestibular schwannomas (Fig. 1) were referred to a higher centre.

Small vessel disease and cerebral volume loss contributed to 35.2% (56 scans). A majority of them were appropriate for age. Thirty scans (18.8%) were found to have disease in mastoid/sinuses/post nasal space. None of them needed any management as they were asymptomatic. Anatomical variants were noted in 15 scans (9.4%). The significant findings included the following: a vascular loop in IAM (8), meningioma in cerebellopontine angle (3), internal carotid artery (ICA) aneurysm (1), subependymal tumour with a pituitary adenoma (1) (Fig. 2), cavernoma (1), and arachnoid cyst in cerebellopontine angle (1). The patients with vascular loop in IAM did not need surgical intervention. The patients with an ICA aneurysm, subependymal tumour, and meningioma were referred to a higher centre. The patients with a cavernoma and an arachnoid cyst were referred to a neurologist and managed conservatively.

Discussion

Our retrospective study included 159 scans of patients who presented with audiovestibular symptoms. All the patients underwent a clinical evaluation, pure tone audiogram, and tympanogram. Subsequently, they underwent an MRI scan of the IAM to exclude any intracranial pathology.

Up to 20% of the patients presenting to ENT department with audiovestibular symptoms are considered potential candidates for vestibular schwannoma screening [4]. There are a few published guidelines for MRI imaging for vestibular schwannoma screening, but there is currently no national consensus on them [5].

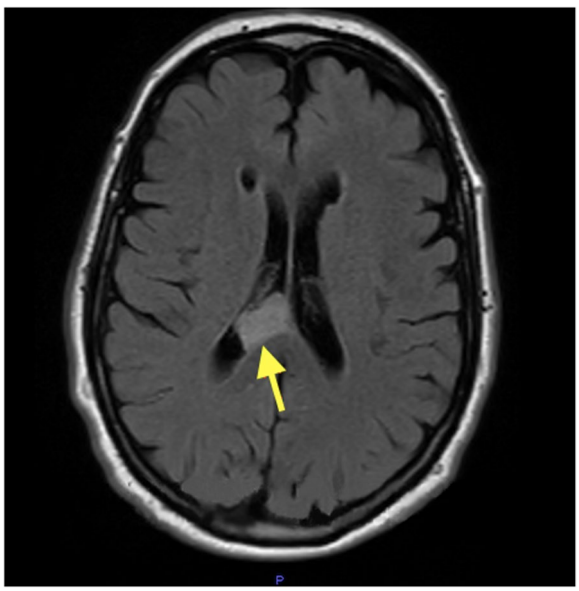

Fig. 2 T2-weighted MRI image of the brain showing a subependymal tumour in the right lateral ventricle

Of note, only 27.2% of our scans were reported as completely normal. Papanikolaou et al. did a retrospective study on 200 MRI scans on patients presenting with audiovestibular symptoms and reported 52% scans being normal [6]. Htun et al. also reported a similar statistics of having 49.5% scans entirely normal [7]. Our study involved various radiologists and inter observer variation has to be taken into consideration.

Our study had a high incidence of small vessel disease and cerebral volume loss (35.2%). This can be due to the increased number of elderly population in our study. Notably, people aged 65 and over constitute 24% of the local population, in comparison with 18% nationally [8]. Cerebral small vessel disease includes white matter lesions and lacunar infarcts and is associated with atherosclerosis, hypertension, diabetes mellitus, atrial fibrillation, and stroke [9].

Nineteen percent of our study population were found to have diseases in the mastoid/sinuses and post nasal space. However, none of them needed any further intervention. A large public health survey done in Norway on 982 participants chosen irrespective of their medical status found a high incidence of sinus diseases. Opacification in the paranasal sinuses was seen in two out of three participants, and mucosal thickening was seen in one out of two. Opacification of sinuses is common and can represent clinical challenges if misinterpreted and not correlated clinically [10].

Anatomical variants were found to be present in 9.4%. It can be difficult to assess the significance of these variants unless the radiologists highlights it as being clinically relevant. In a retrospective study of MRI scans of 2536 healthy young men (17–35 years), normal anatomical variants were present in 18.45% [11].

Vascular loop in IAM was seen in 8 patients. None of them required any surgical intervention. Vascular compression syndrome is believed to be due to close contact between a major artery and a nerve trunk over a prolonged period of time leading to localised demyelination and desynchronisation of impulses. A loop of the anterior inferior cerebellar artery seems to be most often involved, less so the posterior inferior cerebellar artery, the vertebral artery, or a vein [12].

Five patients (3.1%) were found to have vestibular schwannoma. Three were referred to a higher centre for further management and two were kept on surveillance. The detection rate of 3.1% in this study was slightly higher than other studies which reported rates of around 1% [6, 7]. This may be due to the fact that we get a concentrated

group of patients already screened by the general practitioner and audiologist.

Strengths and limitations

Our study categorised the MRI reports into groups based on their clinical relevance. This can help otolaryngologists plan the management of patients with incidental findings. The limitation of our study was the possibility of inter observer variation in the MRI reports due to the reporting done by multiple radiologists.

Conclusion

MRI screening for vestibular schwannoma has a large incidence of incidental findings which has an economic and healthcare impact. It is thus important for the otolaryngologist to assess the findings and plan onward referrals if required.

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Authors' contributions
DP collected the data and wrote the article, GCW analysed and interpreted the data, and RH was involved in the radiological interpretation of the data. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical committee of Wye Valley NHS Trust stated that ethical committee clearance is not required for this study. Consent to participate was not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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