Case Report

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Is vestibular schwannoma really a benign tumor? Case report and review

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Introduction: Vestibular schwannoma (VS) is a benign tumor that develops from Schwann cells of the eighth cranial pair, mainly in the cerebellopontine angle.

Case Presentation: We report the case of a 30-year-old female patient who developed left otalgia associated with neglected tinnitus, the evolution of which was marked by the development of a static cerebellar syndrome and a behavioral disorder, whose brain MRI revealed a locally advanced process in the cerebellopontine angle at the expense of the vestibulocochlear nerve, in favor of a VS, complicated by involvement of the tonsils, which unfortunately led to the patient's death.

Discussion: VS, formerly known as acoustic neuroma, is an extra-axial intracranial tumor that accounts for over 80% of pontocerebellar angle tumors, and is secondary in the majority of cases to inactivation of the neurofibromatosis type 2 (NF2) tumor suppressor gene, either by mutation of the NF2 gene or loss of chromosome 22q. In the majority of cases, it is unilateral and solitary, but in almost 8% of cases, it is associated with NF2. Cerebral MRI is the examination of choice for the detection, characterization, and diagnosis of VS without the need for biopsy, mainly with T1-weighted sequences before and after gadolinium injection. Treatment is based essentially on surgery or radiosurgery, depending on the size, impact, and expertise of the treatment team.

Conclusion: VS remains an important intracranial tumor entity, which can be life-threatening in cases of advanced local invasion.

Keywords: evoked potentials, neurofibromatosis type 2, radiosurgery, Schwann cells, vestibular schwannoma

Introduction

Vestibular schwannoma (VS), or acoustic neuroma as it was formerly known, is a significant intracranial tumor entity and is classified as the third most common benign intracranial tumor after meningioma and pituitary adenoma[1]. It is the most common extra-axial tumor, with the majority of its localization in the cerebellopontine angle. Its extensive involvement of the posterior cerebral fossa makes this tumor, when locally advanced, a significant malignancy, compressing vital structures such as the brain stem[2].

In this paper, we report the case of a healthy young patient who presented with 3 weeks of otalgia associated with peripheral facial paralysis, in whom brain MRI revealed a locally advanced process of the pontocerebellar angle suggestive of VS, which was complicated by tonsillar involvement leading to the patient's death despite attempted decompression.

HIGHLIGHTS

- Vestibular schwannoma (VS) is a benign tumor that develops from Schwann cells of the eighth cranial pair, mainly in the cerebellopontine angle.
- VS is an extra-axial intracranial tumor that accounts for over 80% of pontocerebellar angle tumors and is secondary in the majority of cases to inactivation of the neurofibromatosis type 2 (NF2) tumor suppressor gene, either by mutation of the NF2 gene or loss of chromosome 22q.
- Cerebral MRI is the examination of choice for the detection, characterization, and diagnosis of VS without the need for biopsy.
- Treatment is based essentially on surgery or radiosurgery, depending on the size, impact, and expertise of the treatment team.

Case presentation

We report the case of a 30-year-old female patient, with no pathological history, who presented for 3 weeks with recently worsening hearing loss and left otalgia, as well as tinnitus. The evolution was marked by the onset of a behavioral disorder 3 days earlier, severe headaches, and a disturbance of balance, prompting the patient to consult the emergency department. On admission, the patient was confused, with a Glasgow Coma Scale (GCS) of 13/15, anisocoria, and lability of hemodynamic parameters in favor of central dysautonomia.

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Neurological examination revealed a static cerebellar syndrome, with no cutaneous signs suggestive of neurofibromatosis. Biological workup was unremarkable, with normal natremia, calcemia, and renal and hepatic function tests; an audiogram was missed due to technical shortcomings.

Brain MRI with and without gadolinium injection revealed an extra-axial expansive process of the right cerebellopontine angle in T1 hyposignal (Fig. 1) and T2 hypersignal (Fig. 2) and T2 fluid-attenuated inversion recovery (FLAIR), without diffusion restriction, with a few foci of hemorrhagic remodeling in the T2* sequence (Fig. 3).

After gadolinium injection, the enhancement was heterogeneous, more in favor of a VS (Fig. 4). This process measured $80 \times 49 \times 42$ mm, and included areas of the cystic signal that did not enhance. It exerts a mass effect and significant compression on the brainstem, the right cerebellar hemisphere, the middle cerebellar peduncle with tonsillar involvement at the level of the foramen magnum measuring 21 mm on the right, as well as compression of the ventricular system with triventricular hydrocephalus. Given the local invasiveness, size and clinical impact, the decision was taken to refer the patient for radiosurgery, but after decompression. However, the evolution was marked by the appearance of a disorder of consciousness with a GCS of 7/15, with signs of severe intracranial hypertension and severe dysautonomia. A follow-up brain scan revealed no change, apart from very significant dilatation of the lateral ventricles and the third ventricle, with involvement of the amygdala. The decision was taken to perform an urgent ventriculo-external shunt and decompression with deferral of radiosurgery, but unfortunately with no improvement, no postoperative recovery, and cardiovascular arrest due to non-resuscitated electromechanical dissociation. The patient died one day after admission.

The SCARE guidelines were used in the writing of this paper[3].

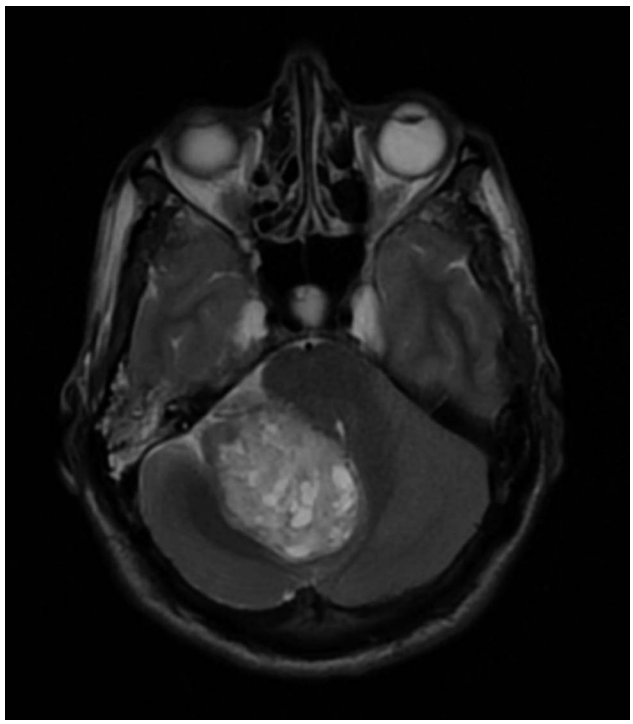

Figure 2. Cerebral MRI in axial section with T2-weighted sequence showing an extra-axial expansive process in iso and hypersignal.

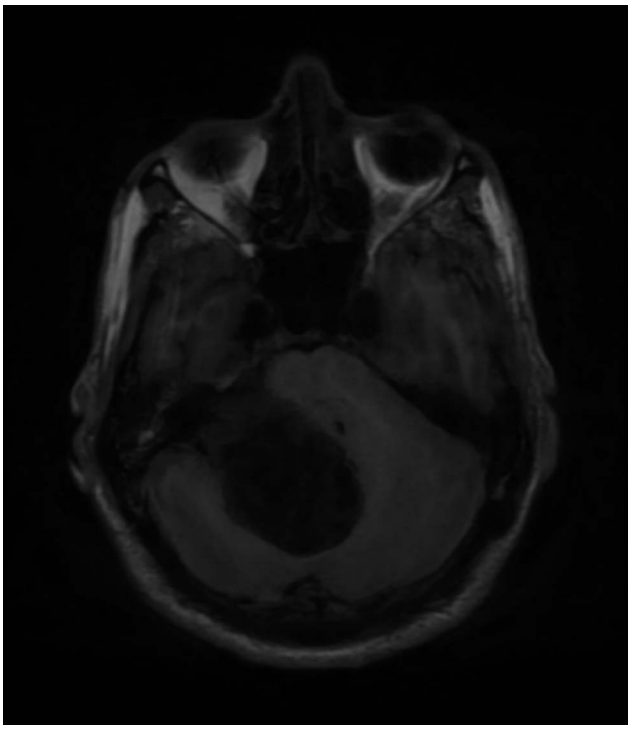

Figure 1. Cerebral MRI in axial section with T1-weighted sequence showing a hyposignal extra-axial expansive process.

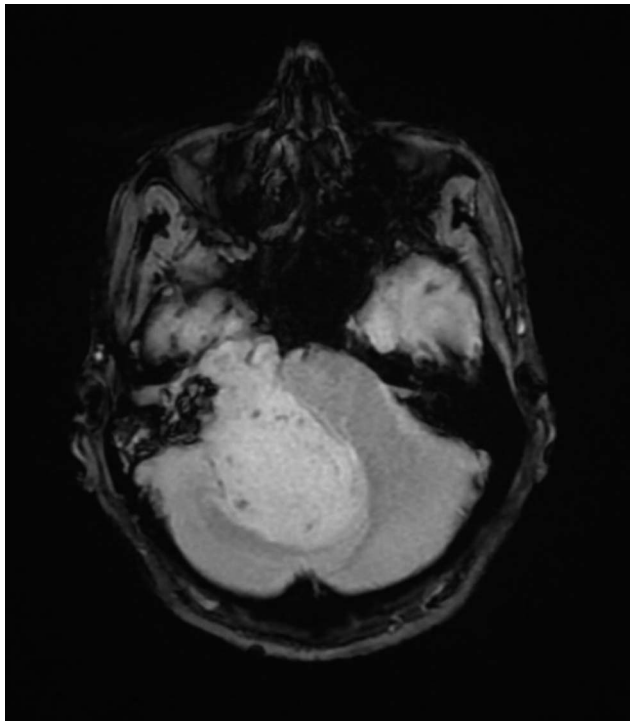

Figure 3. Axial-section cerebral MRI with T2* gradient echo sequence showing hemorrhagic micro focuses in the signal void.

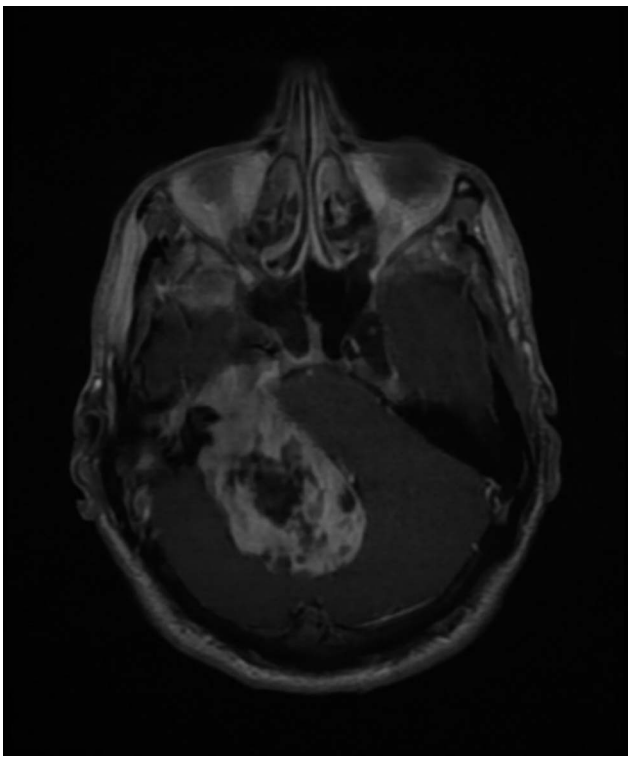

Figure 4. Axial-section brain MRI with T1-weighted sequence after gadolinium injection showing heterogeneous enhancement of the process.

Discussion

VS, formerly known as acoustic neuroma, is an extra-axial intracranial tumor that accounts for over 80% of all pontocerebellar tumors. It is a tumor that develops in the myelinated Schwann cells of the vestibular division of the vestibulocochlear nerve (the eighth of the cranial pairs). Although anatomopathologically a benign tumor, its location and relationship to overly important structures means that its clinical presentation and prognosis are quite heterogeneous, depending on a number of parameters, principally local extension, duration of evolution, and tumor size[4].

From a pathophysiological point of view, schwannoma is secondary in the majority of cases to inactivation of the neurofibromatosis type 2 (NF2) tumor suppressor gene, either by mutation of the NF2 gene or loss of chromosome 22q. This inactivation can be detected by genome sequencing, but in 14% of cases, no abnormalities are detected, and this can be explained by the location of genetic abnormalities in regions not covered by genome sequencing[5].

In the majority of cases, schwannoma is unilateral and solitary, but in almost 8% of cases, it is associated with NF2, a monogenic autosomal dominant disease caused by pathogenic variants of the NF2 gene on chromosome 22q[6].

Although NF2 usually presents as bilateral VS, it can present as unilateral VS with other NF2 features in 15% of patients. NF2 can cause schwannomas throughout the peripheral and central nervous system, and patients may also present with ependymomas and meningiomas, with the resulting morbidity significantly affecting the quality of life and shortening life expectancy. Testing for NF2 is imperative in young patients less than 30 years of age with schwannomas of any location and meningiomas less than 25 years of age. In elderly subjects, NF2 testing should be limited to patients with two tumors linked to an NF2 gene abnormality[7].

Clinically, the most frequent symptom is loss of homolateral sensorineural hearing function, present in 90% of patients, plus vertigo and imbalance, present in 60%. Tinnitus is thus a highly disturbing symptom resulting from loss of the cochlea and cortical maladaptation. Paradoxically, vertigo only occurs in around 8% of cases and can be explained by the relatively slow progression of vestibular loss associated with the indolent evolution of the tumor[4].

In patients with large tumors, compression of the brainstem and cerebellum is possible and may initially manifest as cerebellar ataxia, secondary trigeminal neuralgia, and hydrocephalus, which is initially well tolerated but may later decompensate with cerebral involvement[2]. Although VS is not associated with involvement of the facial nerves or the motor portion of the trigeminal nerve, concomitant involvement is not uncommon, either by a schwannoma on these nerves such as facial nerve schwannoma or by malignant tumors of the peripheral nerve sheath that develop de novo or after radiotherapy (RT) of a VS[8].

Cerebral MRI is the examination of choice for the detection, characterization, and diagnosis of VS without the need for biopsy[9]. The protocol consists of T1-weighted and T2-weighted sequences before and after gadolinium injection, diffusion sequences to differentiate between arachnoid or epidermoid cysts, and FLAIR sequences to detect hemorrhagic tumor foci, which are associated with a poorer prognosis. The VS presents as a solitary mass at the level of the cerebellopontine angle, in close contact with the internal auditory canal, with a hypointense T1 signal that enhances after gadolinium injection[10,11], and a heterogeneous T2 hypersignal, with diffusion restriction. In locally advanced tumors such as ours, cystic and hemorrhagic lesions are detected, and in the majority of cases, calcifications are absent[9].

Histological diagnosis of VS is not necessary, given the high sensitivity and specificity of brain MRI, especially with T1-weighted sequences before and after gadolinium injection, but when a biopsy is performed, it shows a tumor arising from Schwann cells in 80% of the vestibular portion, and in 20% of the cochlear portion of the vestibulocochlear nerve[12]. In hematoxylin/eosin-stained sections, the appearance parallels that of schwannomas in other locations and is specific enough to confirm the anatomopathological diagnosis in the vast majority of cases. The characteristic appearance is made up of Antoni A cellular zones associated with hypocellular microcystic zones. In immunohistochemical analysis, VS is diffusely positive for SOX10 and S100B[13].

There are three possible treatment strategies. Firstly, a conservative strategy, in which patients are monitored clinically, functionally, and with respect to imaging, in order to determine whether an interventional strategy is appropriate. To date, no single parameter has been shown to be superior to others, but gender, age, symptoms of imbalance, hearing loss, initial size, tumor location, and even the side of the tumor are the most widely studied factors for predicting local tumor progression[14]. Generally, it is expected that around 50% of tumors will increase in size after 5 years, with an average growth in maximum diameter of 2.9 mm/year, and that after 3–4 years, 50% of patients will have a decline in functional hearing[15].

The decision to undergo surgery depends on tumor size, location, clinical and functional impact, patient choice, and the expertise of the treatment team. This decision can be guided by several classification systems, principally the Koos system. Whenever the grade of the tumor according to the Koos classification is higher, then the indication for surgery is more reasonable[4]. The aim of surgery remains total removal of the tumor, or if necessary, near-total removal, since it has been widely demonstrated that incomplete resection is associated with a very high risk of recurrence, which varies between 3.8%, 9.4%, and 27.6% over a period ranging from 22 to 143 months.

Among the other challenges associated with surgery are preserving hearing function and avoiding facial nerve paralysis. Intraoperative monitoring is therefore widely recommended, with electromyography of the facial nerve using direct electrical stimulation and somatosensory evoked potentials[16].

Stereotactic radiosurgery involves the precise delivery of a high dose of radiation in a single fraction, using linear gas pedal techniques such as the CyberKnife or a cobalt-60-based GammaKnife. This delivery is generally programmed in a single fraction and is indicated for patients with small to medium-sized schwannomas. In the case of large tumors, fractionation is essential, and in this case, fractionated RT will be delivered using up to 10 fractions[15].

For medical treatment, at the time of writing, there is no evidence for any molecule, apart from bevacizumab, which is an anti-vascular-endothelial growth factor antibody with a low level of evidence, and only in NF2 patients[17].

For patient follow-up, brain MRI and audiometry remain essential for close monitoring of recurrence and progression size in patients who have benefited from a conservative strategy[11,17].

Conclusion

VS remains an important tumoral entity of the posterior cerebral fossa, with a markedly increasing incidence. Treatment depends mainly on the size of the tumor, its impact, but above all, on the expertise of the team and the patient's choice.

Ethical approval

The ethical committee approval was not required, given the article type (case report). However, the written consent to publish the clinical data of the patients was given and is available to check by the handling editor if needed.

Consent

Written informed consent was obtained from the patients for the publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Author contribution

I.J. is the first author who contributed to this research by writing up and collating data; S.N. is the second author who contributed to the study concept, data analysis, and collection; N.A, I.K., and I.S. have supervised and validated the final version.

Conflicts of interest disclosure

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Research registration unique identifying number (UIN)

This is not an original research project involving human participants in an interventional or observational study but a case report. This registration was not required.

Guarantor

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