Neurofibromatosis type 2 (NF-2) is a rare autosomal dominant disorder characterized by multiple neoplasms which include meningiomas, schwannomas, and ependymomas. The most common tumors associated with NF-2 are bilateral vestibular schwannomas. We report the case of a 20-year-old female who presented with headaches and decreased vision. She had classical clinical presentation and imaging findings, which led to the diagnosis of NF-2.

**Keywords:** Autosomal dominant disorder, ependymomas, meningiomas, multiple inherited schwannomas, meningiomas, and ependymomas, neurofibromatosis 2, schwannomas

**INTRODUCTION**

Neurofibromatosis (NF) type 2 (NF-2) is a rare autosomal dominant disorder caused by a mutation in a tumor suppressor gene on chromosome 22. The most common presenting symptom is hearing loss related to vestibular schwannomas. Around 10% of patients with bilateral vestibular schwannomas have NF-2.\(^1\)

**CASE REPORT**

A 20-year-old female presented with headaches, decreased vision in the right eye, and ptosis of the left eye for 5 months. Ophthalmological examination revealed optic atrophy of the left eye and myopic chorioretinal degeneration of the right eye. Family history was negative. Physical examination revealed no skin lesions. Contrast-enhanced brain magnetic resonance imaging (MRI) was performed which revealed multiple meningiomas and schwannomas.

**DISCUSSION**

NF-2/multiple inherited schwannomas, meningiomas, and ependymomas is a rare autosomal dominant neurocutaneous/phakomatosis disorder which is caused by a mutation in a tumor suppressor gene on chromosome 22 encoding protein merlin.\(^2\) The reported incidence on NF-2 is 1:50,000.\(^3\) The most common presenting symptom is hearing loss which results from cranial nerve VIII schwannomas.\(^4\) Other presenting symptoms include tinnitus and imbalance. Headaches and seizures can also result due to the meningiomas.

The diagnosis of NF-2 is mostly made based on the family history of NF-2 or the presence of bilateral cranial nerve VIII masses. The average age at presentation is 20–30 years, with 10% presenting before the age of 10 and 18% presenting before the age of 15.\(^5\)

Cutaneous lesions are rare in NF-2 compared to NF-1. Central nervous system (CNS) lesions of NF-2 include bilateral acoustic schwannomas, meningiomas, and ependymomas. The most common spinal tumors in NF-2 are spinal schwannomas, with the cervicothoracic region being the most common site.\(^6\) Malignant transformation of NF-2 lesions is extremely rare as compared to NF-1,\(^7\) however, it is higher than the general population. More than half of the patients present with no prior family history.

Revised criteria for the diagnosis of NF-2 proposed by Gutmann et al. in 1997 are summarized in Table 1.\(^8\) Manchester criteria for diagnosis of NF-2 are summarized in Table 2.\(^5\)

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Diagnostic methods

- Clinical history
- Family history
- Clinical examination including ophthalmic and cutaneous
- MRI brain and spine
- Molecular analysis.

Initial radiological evaluation includes computed tomography or MRI.

Differential diagnoses

- Multiple intracranial meningiomas
- NF-1
- Schwannomatosis/multiple intracranial schwannomas.

Multiple intracranial meningiomas is considered as a diagnosis when two or more meningiomas are
diagnosed on imaging studies either simultaneously or sequentially of same or different histological subtypes at different locations.\[4\] Multiple intracranial meningiomas are usually rare when not associated with NF-2.\[9\]

Schwannomatosis is considered the diagnosis when multiple cranial/spinal/peripheral nerve schwannomas are present in the absence of vestibular schwannomas. Other tumors associated with NF-2 such as multiple meningiomas, ependymomas, or astrocytomas are also not seen.\[10\]

The most common phacomatosis disorder is NF-1, with an incidence of 1:2000 live births.\[11\] Diagnostic criteria for NF1 is summarized in Table 3. Tabular format differentiating NF-1 from NF-2 is summarized in Table 4.\[12\]

**Screening**

The risk of transmission to the offspring from affected individuals is 50%. Screening for these high-risk patients can be initiated at birth. Screening with MRI should start at 10 years of age in high-risk families. Once tumors are diagnosed on MRI, annual follow-up can be done to evaluate disease progression. If there are no lesions on initial scan, screening can be performed every 2–5 years.\[13\]

The presented patient has bilateral CN VIII schwannomas [Figure 1], bilateral trigeminal schwannomas [Figure 2], right hypoglossal schwannomas [Figure 3], left optic meningioma [Figure 4], one spinal meningioma [Figure 5], multiple intracranial meningiomas [Figure 6] and en plaque meningiomas [Figure 7]. Our diagnosis was based on radiological findings, given the family history was negative.

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**Table 2: Manchester criteria for diagnosis of NF-2**

| Diagnostic criteria: | Additional findings: |
|----------------------|---------------------|
| Bilateral cranial nerve VIII/ vestibular schwannomas. | None. |
| Family history of NF2. | Unilateral cranial nerve VIII/ vestibular schwannoma or two of meningioma/ schwannomas/ neurofibroma/ cataract. |
| Unilateral cranial nerve VIII/ vestibular schwannoma. | Two of meningioma/ schwannomas/ neurofibroma/ glioma/ cataract. |
| Multiple meningiomas. | Unilateral CN VIII/ vestibular schwannomas or two of schwannoma/ glioma/ neurofibromas/ cataract. |

**Table 3: Diagnostic criteria for NF1**

**Diagnostic criteria for NF1:**

- Six or more café-au-lait macules.
- Two or more neurofibromas.
- One plexiform neurofibroma.
- Inguinal or axillary freckling.
- Optic glioma.
- Two or more lisch nodules or Iris hamartomas.
- Distinctive osseous lesion- sphenoid wing dysplasia/cortical thinning of long bone with or without pseudarthrosis.
- First degree relative with NF-1 according to the above criteria.

**Table 4: Differentiation of NF1 and NF2**

| Feature | NF 1 | NF 2 |
|---------|------|------|
| Gene    | Chromosome 17 | Chromosome 22 |
| Incidence | 1:2,500-4,000 | 1:50,000 |
| Cutaneous lesions | More common | Less common |
| Cranial lesions | Optic gliomas, Hamartomas, Astrocytoma. | Bilateral acoustic schwannomas, Meningiomas, Ependymomas |
Conclusion
NF-2 is a rare autosomal dominant disorder predominantly involving the CNS due to loss of tumor suppressor function. NF-2 should be in the differential diagnosis of patients with bilateral acoustic schwannomas, even without a positive family history. The presence of bilateral acoustic schwannomas should prompt further investigation for meningiomas, other nerve schwannomas, and ependymomas.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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