tissue defect occurred in the first stage, second-stage operation intervention only when the other side ORN developed. Bone flaps are first choice for reconstruction of BORN postoperative defect, especially fibula OC. For patients who are in poor local and general condition, or have a posterior mandibular defect, reconstruction with tissues flaps may be a good choice.

In conclusion, the principle management of BORN of the mandible is making an individualized plan for each patient depending on their own local and general condition. Well- vascularized bone or soft tissue flaps transfer for reconstruction of BORN of the mandible can obtain a good wound healing or acceptable aesthetic and functional results.

REFERENCES

1. Nabil S, Samman N. Risk factors for osteoradionecrosis after head and neck radiation: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2012;113:54–69
2. Marx RE. Osteoradionecrosis: a new concept of its pathophysiology. *J Oral Maxillofac Surg* 1983;41:283–288
3. Lyons A, Osher J, Warner E, et al. Osteoradionecrosis–a review of current concepts in defining the extent of the disease and a new classification proposal. *Br J Oral Maxillofac Surg* 2014;52:392–395
4. Marx RE, Tursun R. Suppurative osteomyelitis, bisphosphonate induced osteonecrosis, osteoradionecrosis: a blinded histopathologic comparison and its implications for the mechanism of each disease. *Int J Oral Maxillofac Surg* 2012;41:283–289
5. Annane D, Depondt J, Aubert P, et al. Hyperbaric oxygen therapy for radionecrosis of the jaw: a randomized, placebo-controlled, double-blind trial from the ORN96 study group. *J Clin Oncol* 2004;22:4893–4900
6. McLeod NM, Pratt CA, Mellor TK, et al. Pentoxifylline and tocopherol in the management of patients with osteoradionecrosis, the Portsmouth experience. *Br J Oral Maxillofac Surg* 2012;50:41–44
7. Costa DA, Costa TP, Netto EC, et al. New perspectives on the conservative management of osteoradionecrosis of the mandible: a literature review. *Head Neck* 2016;38:1708–1716
8. Raggio BS, Winters R. Modern management of osteoradionecrosis. *Curr Opin Otolaryngol Head Neck Surg* 2018;26:254–259
9. Rommel N, Kesting MR, Rohleder NH, et al. Surgical management of severe osteoradionecrosis of the mandibular bone by using double free flap reconstruction. *J Craniomaxillofac Surg* 2018;46:148–154
10. Baumann DP, Yu P, Hanasono MM, et al. Free flap reconstruction of osteoradionecrosis of the mandible: a 10-year review and defect classification. *Head Neck* 2011;33:800–807
11. Lee M, Chin RY, Eslick GD, et al. Outcomes of microvascular free flap reconstruction for mandibular osteoradionecrosis: a systematic review. *J Craniomaxillofac Surg* 2015;43:2026–2033
12. He Y, Liu Z, Tian Z, et al. Retrospective analysis of osteoradionecrosis of the mandible: proposing a novel clinical classification and staging system. *Int J Oral Maxillofac Surg* 2015;44:1547–1557
13. Curi MM, Oliveira dos Santos M, Feher O, et al. Management of extensive osteoradionecrosis of the mandible with radical resection and immediate microvascular reconstruction. *J Oral Maxillofac Surg* 2007;65:434–438
14. Marx RE. A new concept in the treatment of osteoradionecrosis. *J Oral Maxillofac Surg* 1983;41:351–357
15. Chang DW, Oh HK, Robb GL, et al. Management of advanced mandibular osteoradionecrosis with free flap reconstruction. *Head Neck* 2001;23:830–835
16. He Y, Ma C, Hou J, et al. Chinese expert group consensus on diagnosis and clinical management of osteoradionecrosis of the mandible. *Int J Oral Maxillofac Surg* 2020;49:411–419
17. Shan XF, Li RH, Lu XG, et al. Fibular free flap reconstruction for the management of advanced bilateral mandibular osteoradionecrosis. *J Craniofac Surg* 2015;26:e172–e175
18. Jacobson AS, Buchbinder D, Urken ML. Reconstruction of bilateral osteoradionecrosis of the mandible using a single fibular free flap. *Laryngoscope* 2010;120:273–275
19. Cannady SB, Dean N, Kroeker A, et al. Free flap reconstruction for osteoradionecrosis of the jaws–outcomes and predictive factors for success. *Head Neck* 2011;33:424–428
20. Baker SR. Management of osteoradionecrosis of the mandible with myocutaneous flaps. *J Surg Oncol* 1983;24:282–289

Cerebellum Tumor Presenting Itself With Positional Vertigo and Benign Paroxysmal Positional Vertigo

Abdullah Kinar, MD, Ceren Günebakan, MD,† and Ayşe Kübra Şap Kinar, MD‡*

Abstract: The purpose of this case is to describe the positional vertigo observed in a patient diagnosed with cerebellar arteriovenous malformation, pay attention to the importance of medical history taking and physical examination in vertigo patients.

A 51-year-old patient went to the Ear, Nose, and Throat clinic with a complaint of vertigo. His vertigo was like peripheral vertigo at the beginning. Dizziness was triggered by head movements. He experienced tinnitus in the left ear during vertigo attacks. The patient also had neck pain. In physical examination, natural bilateral tympanic membrane and facial examination were observed. Other physical examinations were normal. In the positional vertigo tests, the right Dix-Hall Pike test was positive and a downbeating geotropic nystagmus was found. The patient was treated with canalith repositioning maneuver (Epley maneuver). Oral medical treatment started and after 4 days, the patient reported that his gait balance was disturbed and his neck pain continued. After that magnetic resonance imaging was requested. Magnetic resonance imaging was consistent with cerebellar arteriovenous malformation. The patient was consulted to the neurology service.

Cerebellar arteriovenous malformation had features like to peripheral vertigo, and the correct diagnosis is made due to suspected headache and other neurological symptoms.

Key Words: Arteriovenous malformation, cerebellum, medical history taking, positional vertigo, tumor

Positioning nystagmus is defined as the nystagmus generated by a change in head position with respect to gravity. It is classified

From the *ENT Clinics; †Department of Neurology, Afyonkarahisar State Hospital; and ‡Department of Neurology, Afyonkarahisar Health Sciences University, Afyonkarahisar, Turkey.

Received May 15, 2021.
Accepted for publication June 10, 2021.

Address correspondence and reprint requests to Abdullah Kinar, MD, Afyonkarahisar State Hospital, Orhangazi Nedim Helvacioğlu Blv. No: 73, Afyonkarahisar 03030, Turkey;
E-mail: abdullahkinar@gmail.com

Informed consent was obtained from the participants included in the study.
The authors report no conflicts of interest.

ISSN: 1049-2275
DOI: 10.1097/SCS.0000000000007896

according to the site of lesion (peripheral versus central) and characteristics (paroxysmal versus persistent). The most common known positional vertigo is benign paroxysmal positional vertigo (BPPV), but central positional nystagmus or vertigo should also be known by Ear, Nose, and Throat (ENT) physicians. Paroxysmal forms of central positioning nystagmus are ascribed to enhanced responses of the vestibular afferents during positioning due to lesions involving the nodulus and uvula. Central positioning nystagmus can be observed in cerebellum tumors.[1]

The purpose of this case is to describe the positional vertigo observed in a 51-year-old patient diagnosed with cerebellar arteriovenous malformation disease, pay attention to the importance of anamnesis and physical examination in vertigo patients.

CLINICAL PRESENTATION

The 51-year-old patient applied to the ENT outpatient clinic with the complaint of dizziness for about 2 months. The patient's dizziness was occurring from time to time, and there was no feeling of dizziness after the attack passed. Vertigo was lasting 1 to 2 minutes at most. Vertigo was accomplished with nausea and vomiting mostly. Dizziness was triggered by head movements. There was tinnitus in the left ear during dizziness. There was no hearing loss. The patient also suffered from neck pain during vertigo. There were no other neurological findings such as headache, speech disorder, numbness in hands and arms, blurred vision, visual impairment, etc did not exist. The patient has also had chronic obstructive pulmonary disease and he was using his chronic obstructive pulmonary disease medications. He had no other known illnesses. There was no special trait in his family history.

In the systemic examination of the patient, natural blood pressure was observed. Physical examination revealed natural bilateral tympanic membrane and natural bilateral facial examination. Mouth, throat, and nose examinations were normal. Audiometry was bilateral natural, tympanogram was observed bilateral type A. Positional tests were requested for the patient. In the positional vertigo tests performed by an expert audiologist, the right Dix-Hall Pike test was positive, and downbeating geotropic nystagmus was found and accelerating to the right side.

Treatment and Prognosis

The patient was treated with canalith repositioning maneuver (Epley maneuver). The patient's symptoms were relief after the maneuver. Diphenhydramine tablet twice daily (2×1) in the first 3 days and Betahistine 24 mg twice daily (2×1) treatment started from the fourth day. The patient examinated in fourth day control. On the fourth day, the patient reported that his gait balance was disturbed and his neck pain was continuing, and then brain magnetic resonance imaging (MRI) and temporal MRI was planned. In the temporal MRI conclusion report of the patient, the findings were normal. In the brain MRI conclusion report, a lesion was observed in the midline level of the cerebellum, measured in dimensions of $46 \times 32 \times 36$ mm (TR × AP × CC), with peripheral predominantly in the amorphous hyperintense components at T1 weighted series, and heterogeneous, predominantly hyperintense, locally hypointense serpiginous areas around the lesion was found in the T2 weighted series. It was evaluated as AVM. Secondary to this lesion, compression in the fourth ventricle was observed (Fig. 1).

The patient was consulted to the neurology service. Evaluation with digital subtraction angiography is recommended for this tumor. Since digital subtraction angiography could not be performed in our province, the patient was consulted to an external center.

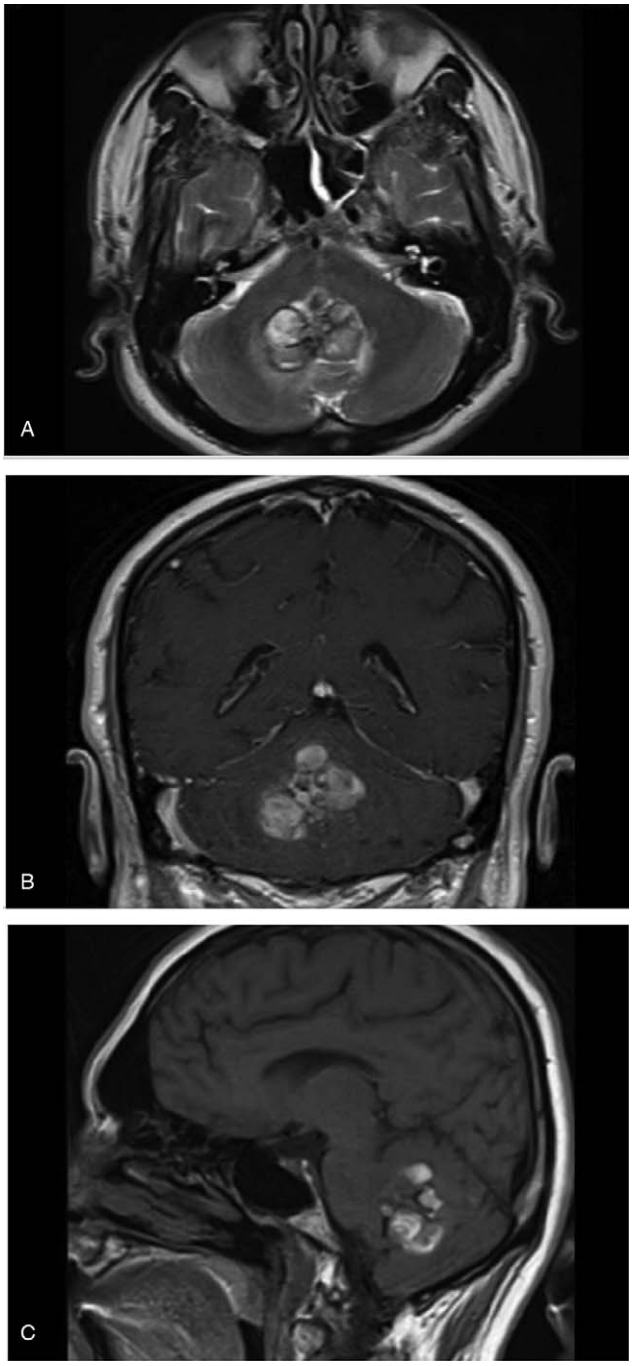

FIGURE 1. (A) $46 \times 32 \times 36$ mm cerebellar AVM view of the patient in MRI T2 axial sections in the midline level of the cerebellum, measured in dimensions of $46 \times 32 \times 36$ mm (TR × AP × CC), with peripheral predominantly in the amorphous hyperintense components at T1 weighted series, and heterogeneous, predominantly hyperintense, locally hypointense serpiginous areas around the lesion was found in the T2 weighted series. (B) View of the patient in MRI T1 coronal sections (C) View of the patient in MRI T1 sagittal sections. AVM, arteriovenous malformation; MRI, magnetic resonance imaging.

DISCUSSION

Cerebellar arteriovenous malformation is one of the diseases of the circulatory system and manifests clinically with headache, vomiting, cerebellar ataxia and or progressive neurological symptoms.

The most common complications of AVMs are intracranial hemorrhages and seizures.[2]

However, few cases have been reported in the literature, presented with peripheral vertigo and otological symptoms.

In our case, at the beginning, the patient's vertigo complaints were evaluated as bening positional vertigo. The presence of tinnitus, the short duration of symptoms, and the type of complaints described in the anamnesis supported this. In the physical examination, the natural ear examination, the absence of hearing loss and the positivity of the right Dix-Hall Pike test also supported this. The presence of the neck pain after the treatment and the complaints which did not regress after canalith repositioning maneuver, such as the gait balance was disturbed, we suspected from central pathologies and brain MRI and additional examinations were requested, and after that the correct diagnosis was made.

Bang-Hoon Cho et al[3] stated that positional nystagmus is not only due to peripheral vestibular diseases. Positional nystagmus is commonly seen in BPPV, but central positional nystagmus or vertigo in another manner in many studies, may occur with brain tumors. These patients were also primarily diagnosed as BPPV, repositioning maneuvers were applied, but no results were obtained. And then they suspect from central pathologies. In that study, in the cerebellums of 4 patients; 2 patients have hemangioblastoma, 1 patient has a metastatic breast cancer lesions, 1 patient has metastatic renal cell cancer lesions reported.[3]

Similar cases in the literature are as follows:

Sakurako et al[4] reported unilateral hearing loss and headache in a 48-year-old vertigo patient. In the vertigo tests of the patient, rotatory nystagmus, which may be compatible with peripheral vertigo, was observed, VEMP responses were not obtained on the side with hearing loss, and both ears' caloric tests were normal. However, considering the patients' headaches, additional examinations were requested, and the patient was diagnosed with cerebellar AVM.

Masahiro et al[5] observed recurrent left peripheral facial paralysis, left retrocochlear hearing loss and tinnitus in a 21-year-old cerebellar AVM patient, similar to an ear disease. The patient's caloric test, pursuit and optokinetic response tests were normal, but downbeat nystagmus was observed in the neck anteflexion and retroflection.

Emma et al[6] reported in a 43-year-old patient with cerebellar AVM who presented with the complaint of vertigo and had a right Dix-Hall Pike test positivity. Positional downbeat nystagmus without latency was observed, and he showed that physical examination findings may disappear completely. He reported that having unilateral tinnitus and headache directs the physician to radiological imaging and helps him to get the diagnosis. We would like to state that our patient was also had unilateral tinnitus and neck pain.

Joshi P et al[7] describe the cases of 7 patients and central mimics of benign paroxysmal positional vertigo.

Kitae Kim et al[8] presented a 72-year-old man with a complaint of vertigo and initially diagnosed with BPPV. His positional nystagmus did not respond to repeated canalith repositioning maneuvers. After several investigations, they found out a ring-enhancing lesion involving the nodulus of the cerebellum with increased cerebral blood volume with suspicion of tuberculous granuloma involving lung and brain.

The value of our study is this: BPPV is the most common cause of vertigo. Dix-Hall Pike test is one of the routinely used test for diagnosis of BPPV in ENT Clinics. Positivity of positional tests like as a Dix-Hall Pike test, which is mostly done with physicians' naked eyes without any video-oculography in daily routine, may not always BPPV. Central positional paroxysmal nystagmus and BPPV share the same characteristics of positional nystagmus in these positional tests. Central positional paroxysmal nystagmus can be differentiated from BPPV by positional nystagmus induced in multiple planes, temporal patterns of nystagmus intensity, and associated neurologic findings suggestive of central pathologies. Detailed neurologic examinations in addition to positional maneuvers could effectively differentiate central positional paroxysmal nystagmus from BPPV.[9]

Although acute BPPV patients may have aggressive symptoms mimicking neurologic symptoms like dizziness and gait imbalance, additional neurologic findings suggestive of central pathologies should be investigated carefully at the first appointment and the following clinical appointments to all vertigo patients. And also BPPV which refractory to the treatment should be investigated. Clinicians should be careful when the seemingly BPPV does not respond to repeated canalith repositioning procedures. Keeping in mind of these differential diagnosis of BPPV avoid us from malpractices.

Limitations of this study, the patient has a cerebellum tumor but, since DSA could not be performed in our province, the exact diagnosis and the follow-up after diagnosis could not be known. But in this case; we presented the importance of medical history taking, types of positioning vertigo, and a case refractory to canalith repositioning maneuver.

CONCLUSIONS

This patient was correctly diagnosed after careful medical history taking, neurological examinations and proper follow-up. In the literature, a small number of cases of cerebellar tumors have been reported, it may show symptoms like BPPV, and its correct diagnosis made due to suspected headache and other neurological symptoms.

It is known that in Turkey, outpatient ENT clinics are intense in hospitals. Thereby, ENT physicians have to follow up all vertigo patients and take their anamnesis carefully. By this way, we can make the distinction between central and peripheral vertigo exactly. Correct diagnosis and treatment can be achieved.

REFERENCES

1. Macdonald NK, Kaski D, Saman Y, et al. Central positional nystagmus: a systematic literature review. *Front Neurol* 2017;8:141
2. Rutledge WC, Ko NU, Lawton MT, et al. Hemorrhage rates and risk factors in the natural history course of brain arteriovenous malformations. *Transl Stroke Res* 2014;5:538–542
3. Cho BH, Kim SH, Kim SS, et al. Central positional nystagmus associated with cerebellar tumors: clinical and topographical analysis. *J Neurol Sci* 2017;373:147–151
4. Komiyama S, Murofushi T, Yoshimura E. A case of cerebellar arteriovenous malformation presented with vertigo, hearing loss, and headache. *Acta Oto-Laryngologica Case Reports* 2017;2:86–88
5. Kikuchi M, Funabiki K, Hasebe S, et al. Cerebellar arteriovenous malformation with facial paralysis, hearing loss, and tinnitus: a case report. *Otol Neurotol* 2002;23:723–726
6. Argaet EC, Young AS, Bradshaw AP, et al. Cerebellar arteriovenous malformation presenting with recurrent positional vertigo. *J Neurol* 2019;266:247–249
7. Joshi P, Mossman S, Luis L, et al. Central mimics of benign paroxysmal positional vertigo: an illustrative case series. *Neurol Sci* 2020;41:263–269
8. Kim K, Kim HJ, Choi JY, et al. Cerebellar tuberculous granuloma mimicking benign paroxysmal positional vertigo: progression after initial misdiagnosis. *J Neurol* 2019;266:2581–2583
9. Choi JY, Kim JH, Kim HJ, et al. Central paroxysmal positional nystagmus: characteristics and possible mechanisms. *Neurology* 2015;84:2238–2246