Cerebellopontomandibular vascular malformation: a rare type of cerebrofacial arteriovenous metameric syndrome

Case report

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 \checkmark The concept of a cerebrofacial arteriovenous metameric syndrome (CAMS) recently has been posited. A 22-year-old woman presented with gait ataxia. She had unilateral angiomatous lesions involving the lower face, the auricle, and the retromastoid area, as well as the tongue on the right side. Angiography revealed the presence of extensive arteriovenous malformations (AVMs) in the ipsilateral cerebellum and pons, in addition to those located in the facial region. The authors report a case of multiple AVMs of the face, cerebellum, and pons, corresponding to CAMS Type 3, and include a review of the literature.

KEY WORDS • neurocutaneous syndrome • vascular malformation

VARIETY of neurocutaneous vascular lesions or syndromes have been reported; however, sometimes a A particular syndromic malformation is hard to classify as a specific entity. Cerebrofacial arteriovenous metameric syndrome is a newly devised concept.² It encompasses complex vascular malformations that have a metameric distribution in the craniofacial region, and three subtypes have been postulated. Although several authors have reported on distinctive groups of vascular malformations, referred to as unilateral retinocephalic vascular malformation, WBS, or Bonnet-Dechaume-Blanc syndrome, most of these lesions belong to CAMS Types 1 and 2 and display a prosencephalic distribution. In contrast, CAMS Type 3, also known as the rhombencephalic lesion, has rarely been described.24 The authors report a case of multiple vascular malformations of the face, cerebellum, and pons, corresponding to CAMS Type 3, and review the literature about this syndrome.

Case Report

History. This 22-year-old woman was admitted for an evaluation of gait ataxia. At birth an angiomatous lesion was present on the lower right side of her face, and when she was 14 years old she was found to be deaf in the right ear.

Examination. The patient presented with progressive gait ataxia that had developed insidiously over a 3-year period.

She had normal intelligence. No family members were reported to have a similar cranial or cerebral vascular lesion. A neurological examination disclosed a full range of extraocular muscle movement with gaze-evoked nystagmus in horizontal directions, slightly decreased deep tendon reflexes, and dysdiadochokinesia on her right side. Fundo-scopy and fluorescein angiography revealed a normal retinal vasculature. Intraocular pressure was noted to be 10 mm Hg on both sides. The patient's brainstem auditory evoked response did not demonstrate any wave peaks on the right side.

A reddish-purple skin discoloration was observed in the mandibular angle, preauricular, auricular, and retromastoid areas, and on the anterior part of the tongue on the right side (Fig. 1). The skin lesion was soft, swollen, and nonpulsatile. Magnetic resonance imaging revealed diffuse vascular signal voids throughout the entire cerebellar hemisphere, vermis, and pons on the right side (Fig. 1). There was no evidence of hemorrhage and no supratentorial lesion was observed. Angiography revealed facial, cerebellar, and pontine AVMs on the right side (Fig. 2).

Diagnosis and Observation. Given the physical and neuroimaging findings in this case and following a thorough review of the appropriate literature, we made a diagnosis of CAMS Type 3. In view of this woman's mild clinical symptoms despite the extensiveness of the vascular malformations, an expectant approach was chosen. The patient is being followed up periodically.

Discussion

Angiodysplasia consists of angiomatous lesions caused

Abbreviations used in this paper: AVM = arteriovenous malformation; CAMS = cerebrofacial arteriovenous metameric syndrome; WMS = Wyburn-Mason syndrome.

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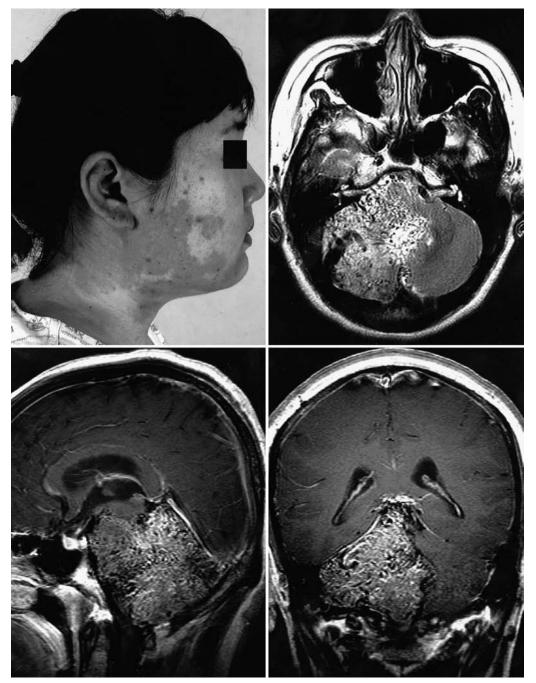


FIG. 1. Upper Left: Photograph of the patient's face showing skin discoloration in the mandibular angle, auricle, and retromastoid areas. Magnetic resonance images demonstrating a massive AVM. In the right side of the posterior fossa, a huge lesion involving the cerebellar hemisphere and the brainstem is shown on an axial T_2 -weighted axial image (upper right) and on Gd-enhanced T_1 -weighted sagittal (lower left) and coronal (lower right) images.

by a faulty embryogenesis of the vascular wall.¹⁰ Huber¹⁰ classified these lesions into three types: 1) diffuse angiomatous phacomatoses; 2) regional angiomatous phacomatoses; and 3) nonangiomatous phacomatoses. The first group includes hereditary hemorrhagic telangiectasia or Rendu-Osler-Weber syndrome, blue rubber bleb nevus syndrome, Mafucci syndrome, Bailey glomangiomatosis, and ataxia telangiectasia or Louis–Bar syndrome. The second group includes encephalofacial angiomatosis or Sturge–Weber

syndrome, WMS or Bonnet-Dechaume-Blanc syndrome, meningocerebral angiomatosis or Divry–van Bogaert disease, cutaneous meningomedullary angiomatosis or Cobb syndrome, congenital venous dysplasia or Klippel-Trenaunay-Weber syndrome, and von Hippel–Lindau disease.

Taking another point of view, these lesions can be divided into arterial, capillary, capillary–venous, venous, lymphatic, and venolymphatic malformations, depending on which channel components are involved (Table 1).^{6,14} These

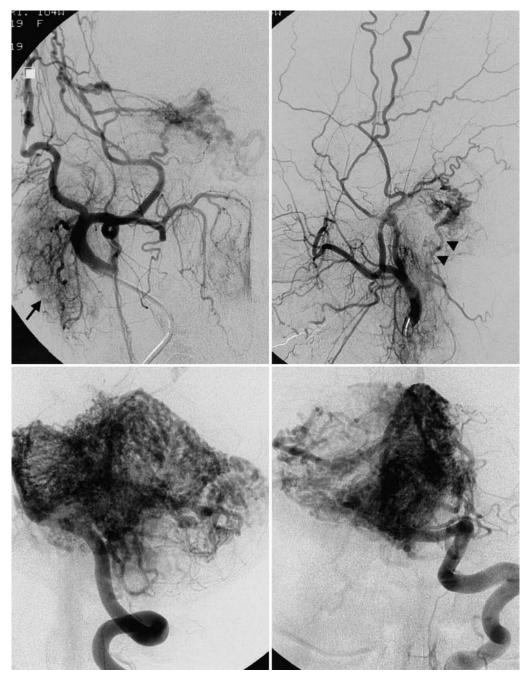


FIG. 2. Angiograms of the lesion. Following an external carotid artery injection, parts of the facial (*arrow*) and intracranial lesions appear opacified in both anteroposterior (*upper left*) and lateral (*upper right*) views. The anterior pontomesencephalic vein, a draining vein of the posterior fossa AVM, can be seen (*arrowheads* in *upper right*). The superior portion of the huge pontocerebellar AVM is opacified in response to the left vertebral artery injection in both the anteroposterior (*lower left*) and lateral (*lower right*) views. Enlarged pontine perforating arteries are distinctive in the lateral view (*lower left*). The inferior portion of the AVM is opacified by the right vertebral artery injection (data not shown).

classifications confound a systemic arrangement, however, and some syndromic neurocutaneous vascular malformations may not fit specific diagnoses.

It is known that Brock and Dyke first documented the combination of retinal, optic nerve, chiasmal, midbrain, and cerebellar involvement by an AVM in 1932.¹⁸ After another description of two cases with racemose angioma in the ipsilateral retina, orbit, and face by Bonnet, et al., in 1937, and

an extensive review by Wyburn-Mason,²⁵ various names have been given to this condition historically, as summarized by Gibo, et al. (Table 2).⁹

The characteristic features of WMS include cutaneous vascular nevi and ipsilateral cerebral AVMs involving the visual pathways from the occipital lobes and thalamus via the hypothalamus, optic chiasm, and optic nerve to the retina.²⁵ Typically WMS is composed of unilateral retino-

Cerebellopontomandibular vascular malformation

TABLE 1	
Syndromic vascular malformations an the channel components involved*	nd

Syndrome	Channel Components Involved
Sturge–Weber	capillary venous [†] or venolymphatic [‡]
Turner/Noonan	lymphatic†
blue rubber bleb nevus	venous†
Maffucci	venous†
Klippel–Trenaunay	capillary lymphaticovenous [†]
Parkes–Weber	capillary venous [†]
Bonnet-Dechaume-Blanc or	capillary venous‡
Wyburn-Mason	
Rendu-Osler-Weber or HHT	venous‡

* HHT = hereditary hemorrhagic telangiectasia.

† According to Burrows.

‡ According to Luo, et al.

cephalic vascular malformations,²² although some authors of case reports have described bilateral lesions,^{11,15,19} and asserted the nonuniversality of retinal involvement.^{25,9,20} Patients present with a combination of symptoms related to cosmetic and psychological problems, life-threatening epistaxis or gingival bleeding, blindness, or cerebral hemorrhage.²⁰ Midbrain or cerebellar involvement has only been rarely described.^{21,22}

It is not easy to explain the pathogenesis of this sort of complex vascular malformation composed of intracranial and extracranial lesions. Ponce and associates²⁰ suggested that a "unilateral dysgenesis of the anterior primordial vascular plexus" was the pathogenetic mechanism of WMS. They also proposed that the syndrome's broad spectrum of manifestation depends on the timing of an embryonic insult at 7 weeks of gestation, the period of optic cup closure, which would represent a critical point in the determination of the presence or absence of an eye and/or midbrain lesion. Although this explanation seems to be adequate to explain a typical case of WMS, it has its own limitation in explaining mandibulopontocerebellar lesions as shown in our case.

A theory (and classification) based on the metamere seems to be more persuasive and inclusive.² According to research on avian embryos in which the quail-chick chimera technique has been used, mesoderm and neural crest cells from a given transverse, or metameric, level occupy the same territory in the face and brain, and the two cell types also cooperate in myogenesis and vasculogenesis.^{1,7,8,13} During vasculogenesis, endothelial cells and the tunica media are derived from the mesoderm and neural crest cells, respectively. Moreover, interactions between *Hox* genes, neural crest cells, and the mesoderm are complex and involve multiple levels of regulation.²³ This complexity may be the causative basis of various metameric vascular malformations.

Based on these embryologic backgrounds, Bhattacharya and colleagues² devised a classification scheme for metameric craniofacial vascular anomalies and reviewed 15 cases of WMS. These authors noted striking similarities between the distribution of lesions in cases of WMS and fate maps of neural crest cells and cephalic mesoderm in avian experiments. They suggested that CAMSs encompass vascular malformations with a metameric distribution in the craniofacial region and are categorized as CAMS 1, 2, and 3 according to the distribution of those lesions (Table 3).

TABLE 2 Various names related to CAMS*

Authors & Year	Names
Bonnet, et al., 1937	retinal cirsoid aneurysm associated w/ facial & cerebral AVMs
Wyburn-Mason, 1943	arteriovenous aneurysm of midbrain & retina & facial naevi
Fishgold, et al., 1952	neuro-retinal angiomatosis
Paillas, et al., 1959	encephalo-retino-facial angiomatosis
Bufford, et al., 1963	retino-optico-mesencephalic aneurysm syn- drome
Rubinstein, 1972	mesencephalo-oculo-facial angiomatosis
Theron, et al., 1974	unilateral retinocephalic vascular malformation
Troost, et al., 1978	racemose hemangioma of retina, thalamus, & midbrain
Morgan, et al., 1985	ophthalmofacial-hypothalamic AVM

* Modified from Gibo, et al.

The syndrome is nonhereditary and is believed to be caused by a somatic mutation in the neural crest or an adjacent cephalic mesoderm prior to migration.^{2,12} Interestingly, this scheme of arteriovenous metameric syndrome can be a continuum embodying CAMS 1, 2, and 3, as well as spinal arteriovenous metameric syndrome 1 to 31, commonly known as Cobb syndrome, along the entire craniocaudal axis.

Whereas cases of CAMS 1 and 2 are relatively common, cases of CAMS 3 have been rarely reported.²⁴ In a series reported by Bhattacharya and colleagues,² the authors found no case with cerebellum, pons, and mandible involvement. Instead they cited a case reported by Theron, et al.²² Our case showed distinctively extensive lesions in the pons and cerebellum and included facial lesions, providing additional substantial evidence for the existence of CAMS 3.

Our lack of knowledge of the natural history of this condition hampers management decisions in cases of this syndromic malformation. Occasionally, resection of the small opticohypothalmic AVM, with or without embolization, has been attempted and has produced satisfactory results.9,16 Embolization can be a treatment option in cases in which there is bleeding from facial lesions.⁴ Otherwise, in view of the risk of treatment, conservative management with careful follow-up review may be chosen.¹⁷ In a case of Bonnet-Dechaume-Blanc syndrome there was evidence of spontaneous involution of a retinal and intracranial AVM.³ Many patients with CAMS are likely to present to isolated specialists in ophthalmology, otolaryngology, and plastic surgery and, therefore, the underlying and unifying condition may go unrecognized.²² A high index of suspicion is required in treating patients with a retinal or facial AVM, in which a systematic neuroimaging evaluation of metamerically related territories seems to be necessary.

TABLE 3

Embryological origin and topographic projection of CAMS*

Туре	Embryological Origin	Topographic Projection
CAMS 1 CAMS 2	medial prosencephalic lateral prosencephalic	hypothalamus, nose occipital lobe, thalamus,
CAMS 3	lateral rhombencephalic	optic tract, retina, maxilla cerebellum, pons, mandible

* According to Bhattacharya, et al.

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