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Case Report

Giant tumefactive perivascular spaces that expanded and became symptomatic 14 years after initial surgery

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Abstract

Background: Perivascular spaces (PVSs) or Virchow–Robin spaces in the brain are pial-lined interstitial fluid (ISF)-filled structures surrounding the penetrating arteries and arterioles. These spaces appear as 1- to 2-mm in diameter, round, oval, or curvilinear smooth-walled structures on magnetic resonance imaging (MRI). Typical PVSs are asymptomatic. Occasionally, they become enlarged and cause specific clinical manifestations that depend on location and the degree of tissue compression. In this case, they are referred to as giant tumefactive PVSs. To our knowledge, there have been no reported cases in which giant PVSs increased remarkably in number and size during both the natural course and postoperative course. We describe a rare progression of giant tumefactive PVSs 14 years after initial surgery.

Case Description: On first admission at age 17, endoscopic ventriculocystostomy and third ventriculostomy were performed to relieve hydrocephalus caused by cysts compressing the cerebral aqueduct. Fourteen years later, the multicystic lesion reappeared with an increase in both cyst number and size. The patient showed no hydrocephalus but presented with oculomotor and trochlear nerve palsies, which were caused by a mass effect on the midbrain. Endoscopic ventriculocystostomy was performed and symptoms improved.

Conclusion: This is the first case report in which giant PVSs increased significantly in number and size.

Key Words: Hydrocephalus, neuroendoscopic surgery, Virchow–Robin space

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INTRODUCTION

Perivascular spaces (PVSs) or Virchow–Robin spaces in the brain are pial-lined interstitial fluid (ISF)-filled structures surrounding the penetrating arteries and arterioles.[12,15] These spaces are believed to form a major pathway for interstitial fluid egress and lymphatic drainage from the brain, and therefore play a significant role in the immune response to viral infections and in the clearance of cellular debris from phagocytosis.[18] In healthy individuals, Virchow–Robin spaces appear as 1- to 2-mm in diameter, round, oval, or curvilinear smooth-walled structures on magnetic resonance imaging (MRI).[4,14] Typical PVSs are asymptomatic. Occasionally, they become enlarged and cause specific clinical manifestations that depend on location and the degree of tissue

compression.[5,13,14,19] In this case, they are referred to as giant tumefactive PVSs. Shunting and fenestration of cysts are effective treatment methods when enlarged PVSs become symptomatic.[2,5,7,9,10,13] Here we describe a rare case of giant tumefactive PVSs that increased in size and number to become symptomatic 14 years after initial neuroendoscopic third ventriculostomy and ventriculocystostomy.

CASE REPORT

A 17-year-old male was referred to our hospital with progressive headache and nausea. Neurological examination showed papilledema, and MRI [Figure 1a–d] revealed hydrocephalus and a bilateral multicystic lesion in the midbrain and thalamus that caused aqueduct stenosis. The signal intensity of the lesion on T1- and T2-weighted images was identical to that of cerebrospinal fluid (CSF). There was no enhancement with contrast media, no evidence of perifocal edema on FLAIR, and no evidence of calcification on computed tomography (CT). He underwent neuroendoscopic surgery for obstructive hydrocephalus caused by the lesion. A cyst with a transparent membrane continuous with the ependyma was responsible for the blockade of the aqueduct. Two stomas were made on the cyst wall by electrocoagulation, and the cyst shrunk. Third ventriculostomy was then performed. Biopsy of the cyst membrane was initially attempted by grasping it with forceps, but this was discontinued because of hemorrhage. Considering the imaging and surgical findings, the multicystic lesion was considered to be PVS dilation. Postoperative MRI [Figure 1e] revealed a marked improvement in hydrocephalus, but no change was observed in the size or number of the multicystic lesion. Headache and nausea improved. After discharge, the patient stopped visiting our hospital based on his own judgment.

Fourteen years later, at age 31, the patient was readmitted to our hospital with progressive double vision and nausea. Neurological examination revealed anisocoria (right pupil: 3 mm, left pupil: 5 mm), and the light reflex was dull in both pupils. Left eye exotropia in the primary position was present. When the patient tilted his head to the right, double vision worsened, while titling to the left resolved the double vision (Bielshowsky sign positive). Eye movement during tracking of moving objects was normal. These findings indicated left oculomotor and right trochlear nerve palsies. MRI [Figure 2a and b] revealed that a multicystic lesion in the midbrain and thalamus had increased in number and size compared with the initial examination at age 17, but hydrocephalus was not present. Radiological appearance was not typical of a tumor, and inflammatory or infectious disease was unlikely in view of

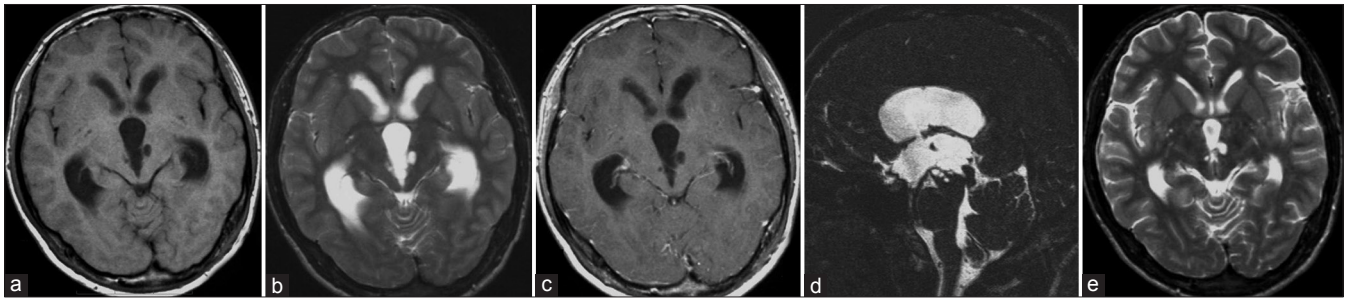

Figure 1: Initial MRI findings in a 17-year-old patient who presented with progressive headache and nausea. Axial T1-weighted (a) T2-weighted (b) contrast-enhanced T1-weighted (c) and sagittal T2-weighted (d) MR images revealed a multicystic lesion in the midbrain and thalamus causing aqueduct stenosis. A T2-weighted image (e) obtained after endoscopic ventriculocystostomy and third ventriculostomy showed a reduction in ventricular size, with no change in the multicystic lesion

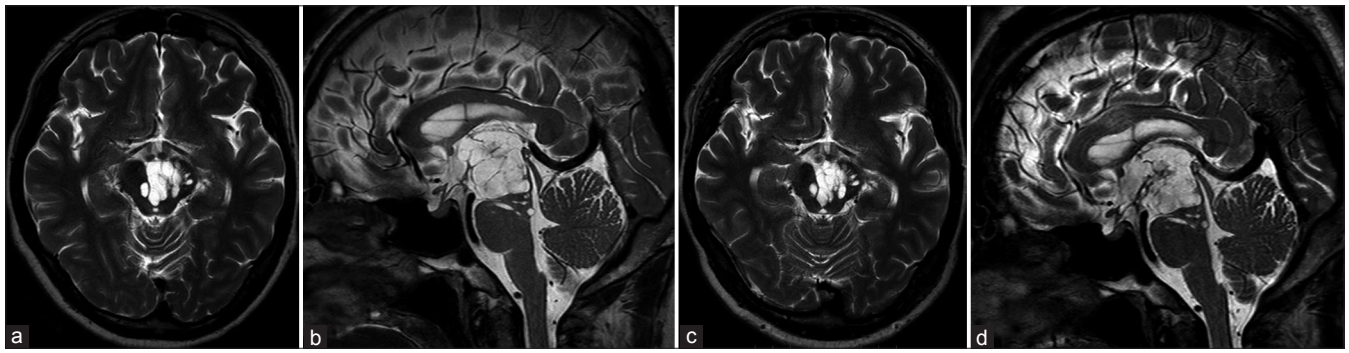

Figure 2: Increase in cyst number and size 14 years after initial surgery. T2-weighted (a) and sagittal T2-weighted (b) MR images revealed a multicystic lesion in the midbrain and thalamus that had increased in number and size, but no hydrocephalus was observed. Axial T2-weighted (c) and sagittal T2-weighted (d) MR images obtained after the second surgery showed a slight reduction in the size of the multicystic lesion

the clinical course. Progression of giant tumefactive PVSs was considered the differential diagnosis.

We speculated that compression of the midbrain was the most probable cause of symptoms and performed neuroendoscopic surgery. Two frontal precoronal burr holes were drilled. Through the left burr hole, we inserted the rigid endoscope with an operating sheath (Karl Storz Inc., Germany) and a neuronavigational guidance probe (Medtronic Inc., USA) into the third ventricle. Through the right burr hole, we inserted the flexible endoscope VEF-IV (Olympus, INC. Japan) with EMF System Pal-1 (Japan Medical Dynamic Marketing Inc., Japan) into the third ventricle. Thin-walled cysts were observed in the third ventricle [Figure 3a]. We fenestrated the cyst walls from rostral to caudal along the midline under the guidance of the navigation system. The interior of the cysts appeared to be traversed by small arteries that were surrounded by enlarged PVSs [Figure 3b]. Specimens of the cyst membrane were retrieved for biopsy.

After surgery, the symptoms and neurological disorder improved. Postsurgical MRI [Figure 2c and d] revealed a slight reduction in the size of the multicystic lesion. Histopathological staining for glial fibrillary acid protein (GFAP) [Figure 4a-c] demonstrated extensive gliosis in the cyst wall. Epithelial cells on the outer aspects appeared to be ependymal cells compressed by the cystic lesion. Based on MRI, surgical, and histological findings, we diagnosed the patient with a multicystic lesion, which was caused by giant tumefactive PVSs. MRI performed at 6 months after surgery [Figure 5] showed a slight reduction in the number and average size of the cysts, and the patient remained free of symptoms.

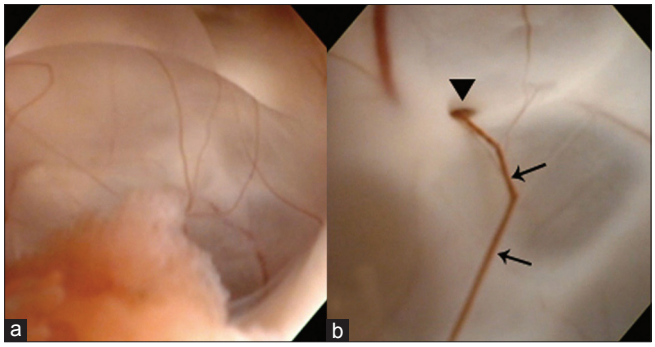

Figure 3: Endoscopic view of the third ventricle (a) showing the thin-walled cysts. After fenestration, an endoscopic view into the interior of a cyst (b) demonstrated perforating arteries (↑) surrounded by an enlarged perivascular space (▲)

DISCUSSION

Virchow–Robin spaces in the brain are normal anatomical structures, but they are often too small for MRI detection.[12,15] In rare instances, they can dilate and form irregularly shaped single or multicystic lesions known as giant tumefactive PVSs.[14] In our patient, dilation of the Virchow–Robin spaces observed by MRI was confirmed by the intraoperative findings.

The precise etiology of the dilation of Virchow–Robin spaces remains obscure. Several hypotheses have been suggested as follows:[1] Abnormally high arterial wall permeability due to vasculitis,[11,2] impaired ISF drainage due to lymphatic obstruction,[6,3] impaired ISF drainage into the ventricles due to increased intraventricular CSF pressure,[3,4] spiral elongation of penetrating blood vessels.[1]

Giant tumefactive PVSs have typical MR imaging features. These are round to oval in shape with a smooth margin along the path of penetrating arteries, are isointense relative to CSF, and show no enhancement with contrast media.[14,15] Although the intensity of adjacent brain parenchyma is usually normal, abnormal signal hyperintensity surrounding giant PVSs is occasionally observed on T2-weighted or FLAIR images of white matter.[8,17]

The most common location of giant tumefactive PVSs is the mesencephalothalamic region in the territory of the paramedian mesencephalothalamic artery.[14] Other common locations include the subcortical white matter, substantia nigra, dentate nucleus, subinsular region,

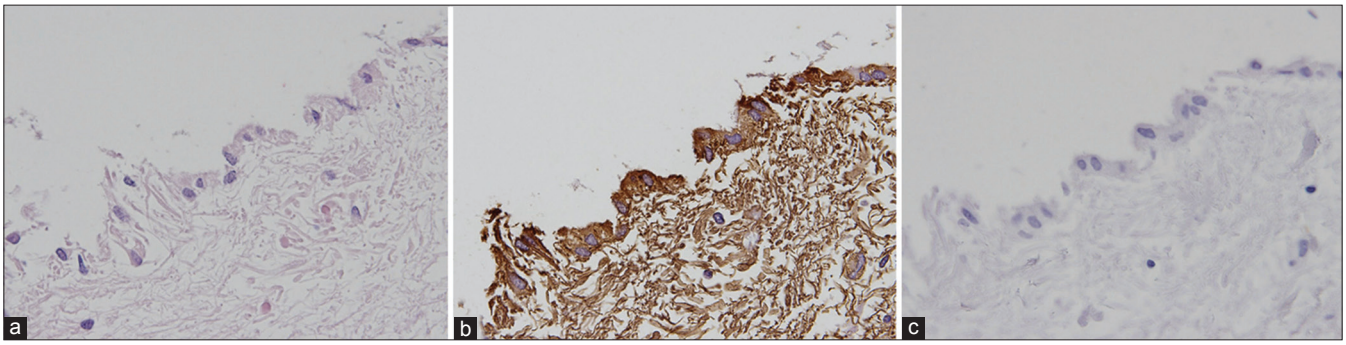

Figure 4: Histological section of a biopsied cyst wall strained with hematoxylin and eosin (a) and immunostained for the astrocytic marker glial fibrillary acidic protein (GFAP) (b) or for the neuronal marker microtubule-associated protein (MAP2) (c) GFAP immunostaining revealed extensive gliosis in the cyst wall. Epithelial cells on the outer aspects appeared to be ependymal cells compressed by the multicystic lesion. No neurons were identified by MAP2 staining. Original magnification: ×400

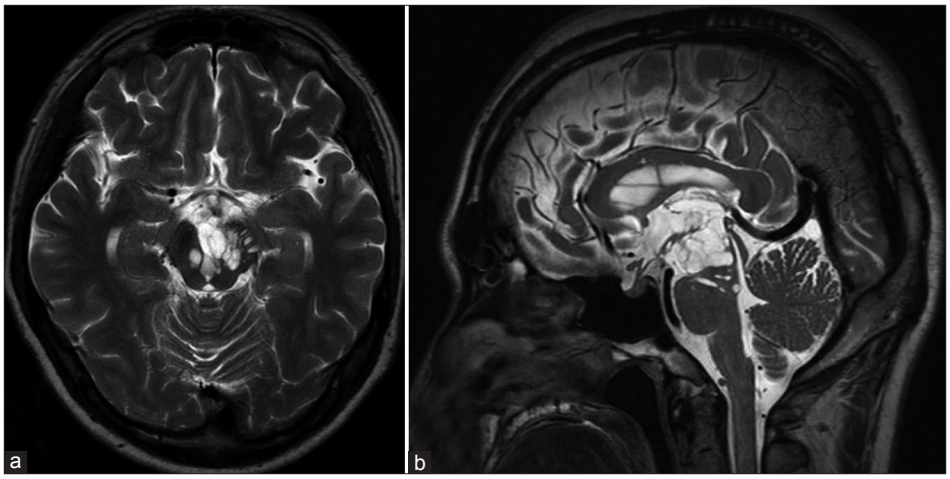

Figure 5: Axial T2-weighted (a) and sagittal T2-weighted (b) MR images obtained 6 months after the second surgery showing a slight reduction in the number and average size of the cysts

corpus callosum, and cingulate gyrus.[14] They can be misinterpreted as other pathological entities, such as cystic neoplasms, parasitic infections, ventricular diverticula, cystic infarction, nonneoplastic neuroepithelial cysts, or mucopolysaccharidosis.[5,9,13]

According to Salzman *et al.*,[14] the clinical symptoms often do not correlate with the location of giant PVSs. The most common symptom associated with giant PVSs is headache, and other symptoms include dizziness, dementia, visual changes, seizure, syncope, stroke, memory problems, poor balance, and poor concentration. When the degree of expansion is sufficient to cause a mass effect, the symptoms are generally consistent with anatomical localization of the lesion. Fayeye *et al.*,[5] reported a patient with giant mesencephalothalamic PVSs presenting with left oculomotor nerve palsy and right abducens and facial nerve palsies. In addition, giant PVSs in the mesencephalothalamic region occasionally cause obstructive hydrocephalus.[2,7,9,10,13]

Asymptomatic cases do not necessarily require any treatment. Longitudinal studies of patients with dilation of PVSs have not been conducted, but follow-up imaging studies in cases published to date have yet to document an increase in PVS size during the natural course.[7,14] Indeed, Stephens *et al.*,[16] reported a patient with relatively stable PVS size with a follow-up of over 17 years. In contrast, symptomatic cases require surgical intervention.[2,5,7,9,10,13] In cases with hydrocephalus, the purpose of the operation is to aid CSF diversion, while cyst drainage and fenestration is required to relieve any focal mass effect. Neuroendoscopy is considered effective because it is relatively safe, does not involve an exogenous shunt, and allows for the removal of tissue samples for biopsy.[13] To our knowledge, approximately 20 reported cases of giant PVSs have been treated using various surgical procedures.[2,5,7,9,10,13] In most cases, CSF drainage was performed to treat hydrocephalus, but the cysts remained stable in size. However, Mascalchi *et al.*,[9] reported a case in which the cysts slightly increased in number and size during a 4-year follow-up period, but no symptom recurrence was observed after initial ventriculoperitoneal shunting for symptomatic hydrocephalus. Conversely, most cases in which the cysts were directly fenestrated or subjected to shunt placement, the cysts decreased in size. House *et al.*,[7] reported a case in which the cyst returned to its original size after fenestration.

To the best of our knowledge, there are no published reports documenting giant PVSs that increased in number and size during both the natural course and postoperative course with emergence of new symptoms. In our case, giant PVSs were sufficiently large to produce a symptomatic mass effect (left oculomotor and right trochlear nerve palsies) 14 years after third ventriculostomy and fenestration of the cysts to relieve obstructive hydrocephalus. As observed in many previous cases, the etiology of giant PVSs progression after initial surgery is obscure. This progression may be affected by initial surgery or may be part of the natural course.

Our case demonstrated that giant PVSs can increase in number and size in the intervening years following surgery.

REFERENCES

1. Awad IA, Johnson PC, Spetzler RF, Hodak JA. Incidental subcortical lesions identified on magnetic resonance imaging in the elderly. II. Postmortem pathological correlations. Stroke 1986;17:1090-7.
2. Caner B, Bekar A, Hakyemez B, Taskapilioglu O, Aksoy K. Dilatation of Virchow-Robin perivascular spaces: Report of 3 cases with different localizations. Minim Invasive Neurosurg 2008;51:11-4.
3. Derouesne C, Gray F, Escourolle R, Castaigne P. 'Expanding cerebral lacunae' in a hypertensive patient with normal pressure hydrocephalus. Neuropathol Appl Neurobiol 1987;13:309-20.

4. Fanous R, Midia M. Perivascular spaces: Normal and giant. Can J Neurol Sci 2007;34:5-10.
5. Fayeye O, Pettorini BL, Foster K, Rodrigues D. Mesencephalic enlarged Virchow-Robin spaces in a 6-year-old boy: A case-based update. Childs Nerv Syst 2010;26:1155-60.
6. Homeyer P, Cornu P, Lacomblez L, Chiras J, Derouesne C. A special form of cerebral lacunae: Expanding lacunae. J Neurol Neurosurg Psychiatry 1996;61:200-2.
7. House P, Salzman KL, Osborn AG, MacDonald JD, Jensen RL, Couldwell WT. Surgical considerations regarding giant dilations of the perivascular spaces. J Neurosurg 2004;100:820-4.
8. Komiyama M, Yasui T, Izumi T. Magnetic resonance imaging features of unusually dilated Virchow-Robin spaces-two case reports. Neurol Med Chir (Tokyo) 1998;38:161-4.
9. Mascalchi M, Salvi F, Godano U, Nistri M, Taiuti R, Tosetti M, *et al.* Expanding lacunae causing triventricular hydrocephalus. Report of two cases. J Neurosurg 1999;91:669-74.
10. Papayannis CE, Saidon P, Rugilo CA, Hess D, Rodriguez G, Sica RE, *et al.* Expanding Virchow Robin spaces in the midbrain causing hydrocephalus. AJNR Am J Neuroradiol 2003;24:1399-403.
11. Poirier J, Barbizet J, Gaston A, Meyrignac C. [Thalamic dementia. Expansive lacunae of the thalamo-paramedian mesencephalic area. Hydrocephalus caused by stenosis of the aqueduct of Sylvius]. Rev Neurol (Paris) 1983;139:349-58.
12. Pollock H, Hutchings M, Weller RO, Zhang ET. Perivascular spaces in the basal ganglia of the human brain: Their relationship to lacunes. J Anat 1997;19 (Pt 3):337-46.
13. Rohlfs J, Riegel T, Khalil M, Iwinska-Zelder J, Mennel HD, Bertalanffy H, *et al.* Enlarged perivascular spaces mimicking multicystic brain tumors. Report of two cases and review of the literature. J Neurosurg 2005;102:1142-6.
14. Salzman KL, Osborn AG, House P, Jinkins JR, Ditchfield A, Cooper JA, *et al.* Giant tumefactive perivascular spaces. AJNR Am J Neuroradiol 2005;26:298-305.
15. Song CJ, Kim JH, Kier EL, Bronen RA. MR imaging and histologic features of subinsular bright spots on T2-weighted MR images: Virchow-Robin spaces of the extreme capsule and insular cortex. Radiology 2000;214:671-7.
16. Stephens T, Parmar H, Cornblath W. Giant tumefactive perivascular spaces. J Neurol Sci 2008;266:171-3.
17. Wani NA, Mir F, Bhat IM, Gojwari T, Bhat S. Giant cystic Virchow-Robin spaces with adjacent white matter signal alteration. Turk Neurosurg 2011;21:235-8.
18. Weller RO, Djuanda E, Yow HY, Carare RO. Lymphatic drainage of the brain and the pathophysiology of neurological disease. Acta Neuropathol 2009;117:1-14.
19. Zacharia TT. Giant tumefactive perivascular spaces manifesting as chorea bilaterally. J Neuroimaging 2011;21:205-7.