Giant Cystic Widening of Virchow-Robin Spaces: An Anatomofunctional Study

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CASE REPORT

Giant Cystic Widening of Virchow-Robin Spaces: An Anatomofunctional Study

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SUMMARY: We describe 2 patients with unusual white matter cystic dilations, which could correspond to widening of the perivascular spaces. They underwent morphologic MR imaging with tractography, functional MR imaging (fMRI), and neuropsychological evaluation. fMRI examination showed no functional reorganization of cortical areas. Tractography showed an apparent decrease of white matter tract vectors into the regions of concern. Findings of the neuropsychological examination were normal. It seems that even an extensive cystic dilation of white matter does not deteriorate brain function.

An extreme widening of Virchow-Robin spaces is a rare entity, because fewer than 10 cases have been reported in the literature.[1-6] We report 2 patients showing unilateral intraparenchymal extensive cystic dilations suspected of corresponding to perivascular spaces. These abnormalities were fortuitously discovered on CT. Both patients underwent a morphologic and functional MR imaging evaluation (tractography, fMRI) associated with a neuropsychological examination.

Case Reports

Patient 1

A 45-year-old man, because of benign head trauma, underwent a nonenhanced CT scan, which revealed a left frontal hypoattenuated lesion. The clinical neurologic and neuropsychological examination findings were normal.

A morphologic MR imaging examination was performed and showed extensive cystic dilations into the left superior (F1) and inferior (F2) frontal gyri, a portion of the left precentral gyrus, the anterior left cingulate gyrus, and the corpus callosum (Fig 1*A*, -*B*).

An fMRI of the right- and left-handed motor tasks (block paradigm, finger tapping, T2* echo-planar imaging [EPI], TR = 2500 ms, TE = 30 ms, matrix = 64 × 64, FOV = 25 cm, 130 frames, image preprocessing [ie, section timing, realigning, coregistering]) and statistical analyses ($P < .001$) were performed by using SPM2 (Wellcome Department of Cognitive Neurology, Queen's College, London; http://www.fil.ion.ucl.ac.uk/spm), and a diffusion tensor imaging acquisition (TR = 7000 ms, TE = 78.6 ms, b = 1000 s/mm^2, 15 directions, matrix = 128 × 128, FOV = 26 cm, section thickness = 3 mm) with fiber tracking (Fibertrack; FuncTool software, Version 3.1.22, GE Healthcare, Milwaukee, Wis) was performed. fMRI (Fig 1*C*, -*D*) showed a cortical activation in the left motor supplementary area in Broadmann areas 4 and 6 after right-handed finger tapping. After the left-handed movement, the activations were identical and symmetric to the right side.

Tractography (Fig 1*E*) showed a decrease of white matter fibers in the pathologic areas compared with the healthy side.

Patient 2

A 57-year-old woman presenting with stability disorders underwent a nonenhanced CT scan, which revealed a left temporoparietal hypoattenuated lesion. The clinical neurologic and neuropsychological examination findings were normal.

A morphologic MR imaging was performed and showed extensive cystic dilations into the left superior and inferior parietal lobules and in the posterior part of the left middle (T2) and inferior (T3) temporal gyri (Fig 2*A*, -*B*).

An fMRI of language (block paradigm, word generation, T2* EPI, TR = 2500 ms, TE = 30 ms, matrix = 96 × 96, FOV = 25 cm, 130 frames, image preprocessing [ie, section timing, realigning, coregistering]) and statistical analyses ($P < .001$) were performed by using SPM2, and a diffusion tensor imaging acquisition (TR = 7000 ms, TE = 78.6 ms, b = 1000 s/mm^2, 15 directions, matrix = 128 × 128, FOV = 26 cm, section thickness = 3 mm) with fiber tracking (Fibertrack) was performed. fMRI (Fig 2*C*) showed a cortical activation in the superior part of the left inferior parietal lobule (Broadmann area 7). A cortical activation was present in the left Broadmann area 44 (F3), which indicates a lateralization of language to the left hemisphere.

Tractography (Fig 2*D*) showed a decrease of white matter fibers in the pathologic areas compared with the healthy side.

Discussion

The term "Virchow-Robin spaces" (or perivascular spaces) refers to the extension of the subarachnoid space accompanying a vessel penetrating the cerebral cortex.[7,8] In case of widening, they can be seen on MR imaging as round, oval, or curvilinear well-defined cystic lesions with smooth margins, isointense to CSF.[1] Fluid-attenuated inversion recovery-weighted MR images should not show any signal-intensity abnormality in the adjacent white matter, but in some cases, hypersignals have been reported corresponding to gliosis.[2]

Hypersignals can be divided into 3 main types according to where they are located: frequently, along the path of the lenticulostriate arteries in the basal ganglia; rarely, along the path of the perforating medullary arteries in the white matter at the

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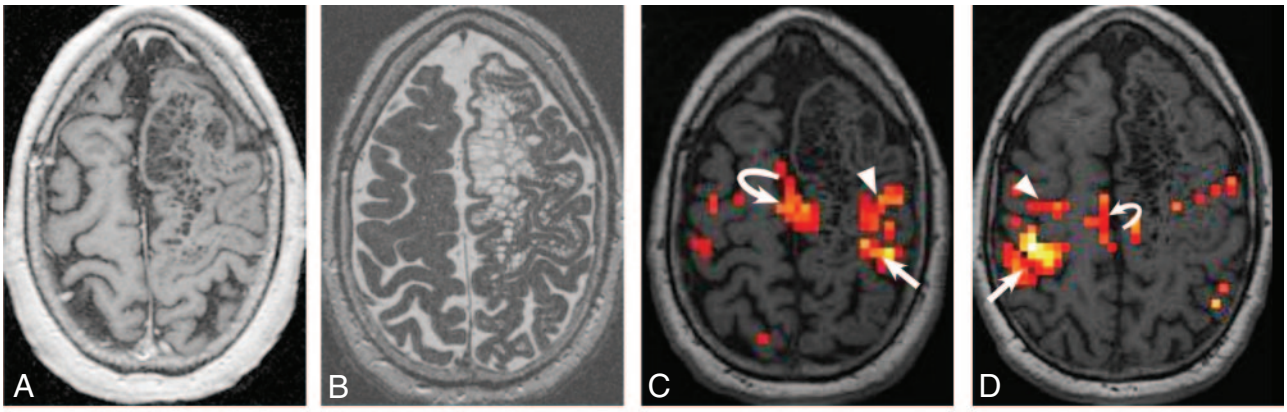


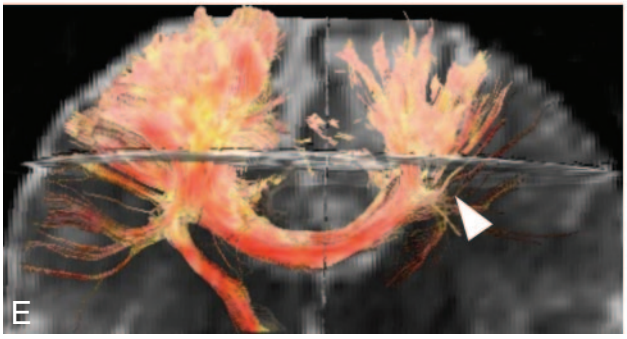
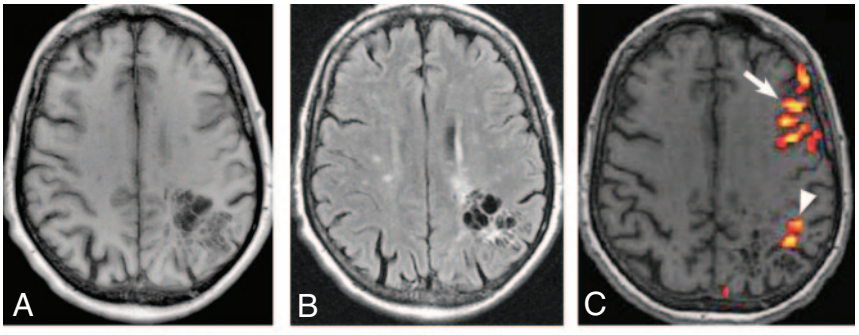


Fig 1. Patient 1. Morphologic MR imaging. *A* and *B*, respectively, Axial 3D-T1 (TR = 13.3 ms, TE = 4.2 ms) and axial 3D-T2 (TR = 3000 ms, TE = 154 ms)-weighted MR images show multiple confluent oval well-defined lesions, isointense to CSF, in the left superior (F1) and inferior (F2) frontal gyri, a portion of the left precentral gyrus, the anterior left cingulate gyrus, and the corpus callosum. These cystic dilations have a mild mass effect, inducing a displacement of the cortical ribbon. *C*, fMRI (motor task of the right hand) shows a cortical activation in the left motor supplementary area (*white curved arrow*) in Broadmann areas 4 (*white arrowhead*) and 6 (*white arrow*). *D*, There is also a symmetric cortical activation when the left hand is stimulated. *E*, The tractography shows a decrease of white matter fibers in the pathologic areas (*white arrowhead*) compared with the healthy side.



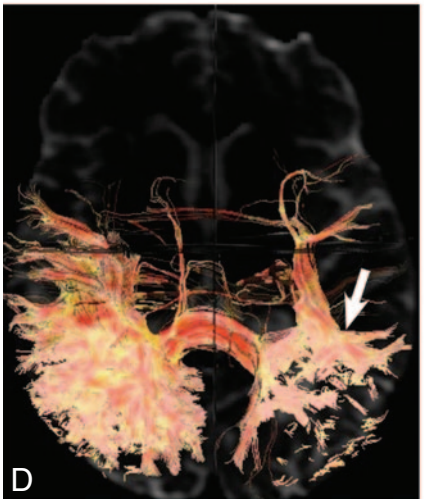


Fig 2. Patient 2. Morphologic MR imaging. *A* and *B*, respectively, Axial T1 (TR = 165 ms, TE = 4.2 ms) and axial FLAIR (TR = 10 000 ms, TE = 155 ms)-weighted MR images show multiple confluent oval well-defined lesions, isointense to CSF, with no mass effect in the left superior and inferior parietal lobules and in the posterior part of the left middle (T2) and inferior (T3) temporal gyri. *B*, FLAIR-weighted MR image shows a hypersignal interspersed among the cystic dilations, which could correspond to gliosis. *C*, fMRI (language task) shows a cortical activation in the superior part of the left inferior parietal lobule (Broadmann area 7, *arrowhead*) in regard to the lesions seen on the morphologic MR imaging. There is also a cortical activation of the left Broadmann area 44 (F3, *white arrow*), which demonstrates the lateralization of language to the left hemisphere. *D*, The tractography shows a decrease of white matter fibers in the pathologic areas (*white arrow*) compared with the healthy side.

upper part of frontal regions; and exceptionally, in the brain stem, predominantly in the pons, around penetrating branches of the collicular and accessory collicular arteries.[1,2]

The size of the cystic lesions is, in most cases, inferior to 1–2 cm.[2,3,7] However, some cases of extreme widening of Virchow-Robin spaces have been reported in the literature.[1-6]

We report 2 patients who presented with extensive cystic dilations of the cerebral white matter. The lesions presented some similarities, with dilation of perivascular spaces as described previously, but we have no pathologic proof. However, we can exclude the main differential diagnoses, which are cystic lesions (ependymal cyst, neuroepithelial cyst, arachnoid cyst, ventricular diverticula, cystic infarction, and mucopolysaccharidosis) because in all these lesions, clinical symptoms or neurologic findings are often present.

Dilations of perivascular spaces, even if giant, are, in most cases, fortuitously discovered because they do not induce any clinical abnormality.[4] However, some atypical presentations have been reported in the literature: Papayannis et al[3] described a patient who presented with a large cystic lesion of the midbrain inducing an acute obstructive hydrocephalus due to the compression of the aqueduct of Sylvius. House et al[6] reported some dilated perivascular spaces that required surgical intervention to relieve mass effect or hydrocephalus.

The extensive white matter cystic dilations were fortuitously discovered in both of our patients because they did not present any neurologic abnormality. The patients underwent a diffusion tensor MR imaging study with tractography and an fMRI associated with a neuropsychological evaluation. fMRI showed no functional reorganization of cortical areas, despite

the apparent extent of the lesions. Tractography showed an apparent decrease of white matter tract vectors into the regions of concern compared with the healthy side. We suspect that this asymmetry between both sides corresponds to a technical limit of tractography rather than to a real decrease in the number of axons. The trajectory of white matter fibers into the corona radiata could be distorted by the presence of cystic dilations; this could lead to modifications of the anisotropy fraction and also to apparent decrease in the number of fibers.

The neuropsychological examination findings were normal in both patients, and these results are in agreement with the previous work by Ugawa et al.[4]

In conclusion, it seems that even giant and extensive white matter cystic dilations, which could correspond to dilation of perivascular spaces, do not deteriorate brain function.

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