Interesting Cases

Neuroradiology Case #11 - 11 yo -- don't know his symptoms

History: None given.
Interesting Cases (cont.)

Neuroradiology Case #11 - 11 yo -- don't know his symptoms

History: None given.
**Answer:** Tumefactive Virchow Robin Space

Please see the attached article with fabulous illustration and some eye popping VR cases. At least look at the pictures.

**Giant Tumefactive Perivascular Spaces**
Karen L. Salzman, Anne G. Osborn, Paul House, J. Randy Jinkins, Adam Ditchfield, James A. Cooper, and Roy O. Weller
Giant Tumefactive Perivascular Spaces

Karen L. Salzman, Anne G. Osborn, Paul House, J. Randy Jinkins, Adam Ditchfield, James A. Cooper, and Roy O. Weller

BACKGROUND AND PURPOSE: The brain perivascular spaces (PVSs) are pial-lined, interstitial fluid-filled structures that accompany penetrating arteries. When enlarged, they may cause mass effect and can be mistaken for more ominous pathologic processes. The purpose of this study was to delineate the broad clinical and imaging spectrum of this unusual condition.

METHODS: Thirty-seven cases of giant PVSs were identified from 1988 to 2004 and were retrospectively reviewed. Clinical data collected included patient demographics, presenting symptoms, and follow-up. Histopathologic data were reviewed when available. Images were reviewed for size and location of the giant PVSs, associated mass effect, hydrocephalus, adjacent white matter changes, and contrast enhancement.

RESULTS: There were 24 men and 13 women with an age range of 6-86 years, (mean 46 years). The most common presenting feature was headache (15 patients). Thirty-two cases had multilocular clusters of variably sized cysts. Five lesions were unilocular. All lesions had signal intensity comparable to CSF and did not enhance. The most common location for the giant PVSs was the mesencephalothalamic region (21/36). Fourteen were located in the cerebral white matter; two were in the dentate nuclei. Nine giant mesencephalothalamic PVSs had associated hydrocephalus, which required surgical intervention.

CONCLUSION: Giant tumefactive PVSs most often appear as clusters of variably sized cysts that are isointense relative to CSF and do not enhance. They are most common in the mesencephalothalamic region and may cause hydrocephalus. Although they may have striking mass effect, giant PVSs should not be mistaken for neoplasm or other diseases.

The perivascular spaces (PVSs) of the brain, also known as Virchow-Robin spaces, are pial-lined interstitial fluid (ISF)-filled structures that accompany penetrating arteries and arterioles for a variable distance as they descend into the cerebral substance (1,2). Recent studies have shown that the PVSs are surprisingly complex entities with significant variability in both ultrastructure and possible function. Routinely, PVSs in many areas of the brain can be identified on T1 images obtained in patients of all ages (4). Occasionally the PVSs may become strikingly enlarged, causing mass effect and assuming bizarre configurations that may be mistaken for a more ominous disease, such as a cystic neoplasm (Figure 1). While scattered cases of giant tumefactive PVSs have been reported (5-7), no large series of these lesions has been presented. The purpose of this study is to delineate the broad clinical and imaging spectrum of giant tumefactive perivascular spaces to further characterize this unusual lesion.

Methods

We performed a retrospective review of all cases of giant PVSs referred for imaging consultation or treated at our institution over a 16-year period spanning 1988 to 2004. Most cases...
We all patients were imaged with MRI imaging using a variety of 1.5T MR imaging units. Typical pulse sequences included T1-weighted spin-echo images, fast spin-echo T2-weighted images, proton density-weighted (PD) images, and fluid attenuated inversion recovery (FLAIR) images. Patients' MR imaging examinations included either a PD or FLAIR sequence. Gd-dolium-enhanced T1-weighted imaging was also performed in most patients (34/36). Two studies were performed without the use of contrast medium. Ten patients underwent CT performed with 5-mm axial sections.

Images were evaluated to determine the size of the giant PVs, establish whether cysts were unilateral or bilateral, and ascertain whether cysts were solitary or clustered. Images were also assessed for the appearance of associated focal or generalized mass effect, hydrocephalus, adjacent white matter changes, and presence of contrast enhancement.

Clinical Findings

Complete clinical data were available in 33 patients with a partial history available in the remaining four patients. The most common presenting symptom was headache, present in 15/33 patients. Other presenting features included dizziness, dementia, visual changes, post-traumatic evaluation, seizures, syncope, stroke, memory problems, cranial neuropathy and poor balance and concentration. One additional patient had a 6th nerve palsy which was found to be related to diabetic neuropathy and resolved on follow-up imaging. One patient who presented with visual changes was ultimately diagnosed with uveitis, which was treated and resolved (Table 1).

Imaging Findings

CT was performed in 10 of 37 patients. All giant PVs were low-attenuation lesions, isodense or isoattenuated relative to CSF, which showed no enhancement following contrast medium administration. No calcifications or other associated abnormalities were identified.

All giant PVs were isointense relative to CSF signal intensity on all MR images regardless of pulse sequence. Contrast-enhanced images were available in 35/37 cases and showed no enhancement. Diffusion-weighted (DW) imaging was available in eight of 37 cases and showed no diffusion restriction.

Lesions were subdivided by location (Table 2). There were 21 lesions with lesions involving the midbrain or thalamus (mesencephalothalamic area) (Fig 2) and 14 lesions predominately involved the hemispheric or subcortical cerebral white matter.

TABLE 1: Presenting symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Patients</th>
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</thead>
<tbody>
<tr>
<td>Headache</td>
<td>15</td>
</tr>
<tr>
<td>Dizziness</td>
<td>3</td>
</tr>
<tr>
<td>Dementia</td>
<td>3</td>
</tr>
<tr>
<td>Visual changes</td>
<td>3</td>
</tr>
<tr>
<td>Post-traumatic evaluation</td>
<td>2</td>
</tr>
<tr>
<td>Cranial neuropathy</td>
<td>2</td>
</tr>
<tr>
<td>Seizure</td>
<td>1</td>
</tr>
<tr>
<td>Syncope</td>
<td>1</td>
</tr>
<tr>
<td>Stroke</td>
<td>1</td>
</tr>
<tr>
<td>Memory problems</td>
<td>1</td>
</tr>
<tr>
<td>Poor balance and concentration</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
</tr>
</tbody>
</table>

There were 27 unilateral lesions and 10 bilateral lesions.
the cerebellar dentate nuclei. In one case, the lesions were bilateral. There was no associated signal intensity alteration in the adjacent brain parenchyma (Fig 7).

**Surgical and Pathologic Findings**

Surgery was performed in 12 patients. In seven cases, biopsy was performed. Histopathologic results in most cases (6/7) disclosed a pial-lined cyst with no evidence of neoplasm or infection. One patient with a midbrain lesion had a layer of pia and arachnoid on the outer aspect of the tissue but no pial lining. This patient had a small fragment, approximately 1 mm cubed, of the cyst lining sent to the pathology department. It was fixed in formalin, embedded in paraffin, and stained with hematoxylin and eosin, hematoxylin van Gieson for collagen, and by immunocytochemistry for glial fibrillary acidic protein (GFAP) for astrocytes (Fig 8A). Figure 8A shows the cyst lining consists of a very thin layer of gliotic brain tissue coated on its outer aspects by collagenous material related to the pia arachnoid on the surface of the midbrain. No lining of pia matter was identified on the inner cyst surface. The brain tissue lining the cyst was extensively gliotic as shown in the GFAP preparation (Fig 8B). Close examination of the cells in the brain tissue lining the cyst shows that it is mainly composed of astrocytes (Fig 8C). The absence of a lining of pia matter is only to be expected in this case, as the cyst was very large and it is unlikely that the thin delicate lining surrounding a vessel would be stretched to this extent. When there is less extensive enlargement of perivascular spaces, the lining of pia matter may remain.

Two patients had a ventriculoperitoneal shunt placed, and the size of the giant PVSs was stable in each case. Another patient had a cystoperitoneal shunt placed, and there was a decrease in the size of the giant PVS from 10 cm to 5 cm. In this case, the patient’s headache also improved. However, the fluid reaccumulated after the patient had a minor traumatic insult, and the giant PVS enlarged to near-presentation size. One patient underwent PVS drainage followed by ventriculoperitoneal shunt placement after the PVS returned to its original size. Five patients underwent a third ventriculostomy; three of these patients also had a biopsy of the cyst wall.

Follow-up MRI imaging was available in seventeen patients from 1 to 2 years after the initial diagnosis. No interim change was seen on repeat MRI imaging in any case.
Fig 2. Axial T2-weighted (A), postcontrast axial T1-weighted (B), and postcontrast coronal T1-weighted (C) images obtained in a 45-year-old man with headaches show a nonenhancing multiloculated cystic mass in the right midbrain, thalamus, and right medial temporal lobe. The cysts follow CSF signal intensity on all pulse sequences and do not enhance. Follow-up imaging 13 years later showed no change. Biopsy proved pial-lined giant perivascular spaces.

Fig 3. Coronal postcontrast T1-weighted image obtained in a 66-year-old woman with headaches shows a nonenhancing unicocular giant perivascular space (black arrow) in the left thalamus with compression and displacement of the third ventricle (white arrow). Note associated hydrocephalus. Surgery disclosed a smooth walled cyst with no abnormality in the adjacent brain. The patient initially underwent a cyst fenestration with a decrease in the size of the PVS. Four months later, there was reaccumulation of fluid and the PVS enlarged to its original size. A ventriculoperitoneal shunt was then placed, which relieved the hydrocephalus. Follow-up studies showed no change in cyst size over 4 years.

was to delineate the classic imaging appearance of giant PV Ss in an effort to prevent misdiagnosis and unnecessary biopsy.

Typical PV Ss occur in many locations. The most

CSF, and demonstrate no enhancement following contrast medium administration (4, 6, 8, 9). When PV Ss become enlarged, they are known as giant PV Ss, \textit{\textdagger} or Poirier's Type IIIb expanding lacunae (6, 10, 11).

Giant PV Ss are expanded PV Ss that occur along the penetrating vessels, most commonly in the mesencephalothalamic region in the territory of the paramedial mesencephalothalamic artery and in the cerebral white matter (4, 7, 10). They differ from typical PV Ss in that they are larger in size and may have associated focal mass effect. In addition, white matter giant PV Ss may have associated T2 and FLAIR signal intensity alteration in the adjacent white matter.

Patients usually present with nonspecific findings that are not attributable to the giant PV Ss. In our series, headache was the most common presenting feature and occurred in approximately 50\% of our patients. Other presenting complaints included dizziness, dementia, visual changes, post-trauma, seizure, syncope, memory problems, poor balance, and poor concentration. Several studies have found that the clinical features of patients with this type of lesion do not correlate with the imaging findings or have been found incidentally at autopsy (9,12–14). However, widespread dilatation of the PV Ss has been reported in association with dementia and parkinsonism (15, 16). Some authors have correlated large convexity and white matter PV Ss with increasing age (4). Others have concluded that the prevalence of basal ganglia
Fig. 4. Sagittal T1-weighted (A), axial FLAIR (B), and coronal T2-weighted (C) images obtained in a 71-year-old man with dementia show extensive involvement of the hemispheric and subcortical white matter with multilocular giant perivascular spaces. The coronal image shows the marked asymmetry of the lesions. Note the scattered focal white matter changes surrounding some of the lesions (black arrows) seen best on the FLAIR image. Case courtesy of Anthony Doyle, MD.

Fig. 5. Sagittal T1-weighted (A), axial FLAIR (B), and axial T2-weighted (C) images obtained in a 46-year-old woman with a visual field defect show extensive involvement of the corpus callosum and cingulate gyrus (A, white arrow) with extension to the subcortical white matter of the parietal and occipital lobes. There is slight increased signal intensity surrounding the lesions, best seen on FLAIR image (B, white arrows). The gray matter is stretched and displaced over the multiloculated giant perivascular spaces. Case courtesy of Leona Valanne, MD.
shunt surgery (19). FLAIR imaging typically shows complete signal intensity suppression without abnormalities in the adjacent parenchyma. In a few reported cases, small foci of high signal intensity adjacent to the cystic spaces have been identified (20). Our study shows that giant PVs that occur in the white matter may have surrounding signal intensity abnormality seen on T2-weighted or FLAIR images, as seen in half of our cases. Lesions with adjacent white matter changes can be divided into two groups. In elderly patients in our series, the white matter changes surrounding the dilated PVs were discrete areas of abnormal T2 and FLAIR hyperintense signal intensity abnormality. One possible theory is that this associated signal intensity alteration may represent advanced chronic ischemic change related to mass effect of the PVs (5). Another possibility is that dilated PVs may result from chronic mechanical stress caused by high blood pressure on the brain arteries (21). However, most hypertensive patients weighted images occurs in more than 30% of the neurologically healthy elderly population (9, 22, 23). Histopathologic study with MR imaging correlation has indicated that many of these lesions are PVs (8, 24, 26). One author found that PVs greater than 2 mm were found in 67 (8%) of 816 patients (4).

Giant PVs (up to 2.3 cm in diameter) have been reported to occur as a normal variant (4, 27). The precise etiology of these enlarged PVs is unknown. Spiral elongation of the penetrating blood vessels has been suggested as one possible cause of this phenomenon (24). Increased CSF pulsations, the ex vacuo phenomenon, or an abnormality of arterial wall permeability have also been cited as contributing factors (9, 13, 28, 29).

Experimental studies suggest that the perivascular spaces are the routes by which interstitial fluid (ISF) drains from brain tissue (30). In humans, amyloid beta (Aβ) appears to be entrapped within the drainage pathways in the cerebral amyloid angiopathy that
tery is fenestrated, accumulation of brain interstitial fluid between the vessel and pia or within the interstitial space causes the PVSSs to enlarge (27). We found that giant PVSSs are most common in the mesencephalothalamic region, which may indeed be related to the close proximity of these vessels to the ventricles. Reactive astrocytes are seen toward the bottom of the illustration. No neurons were identified. (Hematoxylin and eosin stain, original magnification 3×40)

The appearance is virtually pathognomonic of giant PVSSs. An extensive differential diagnosis is superfluous and biopsy unnecessary (14).
have associated mass effect, they should not be mistaken for neoplasm or other disease.

References