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GRAPHICS

Evaluation of Incidental Findings on MRI of the Central Nervous System: Part II

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During the course of routine neuroradiologic imaging evaluation, various abnormalities are occasionally identified that may be considered ''incidental findings.'' The significance of these is not always clear, and additional evaluation may be necessary. Part 2 presents an additional series of magnetic resonance (MR) images to illustrate several ''incidental findings,'' describe their significance, and discuss where additional evaluation or follow-up may be required.

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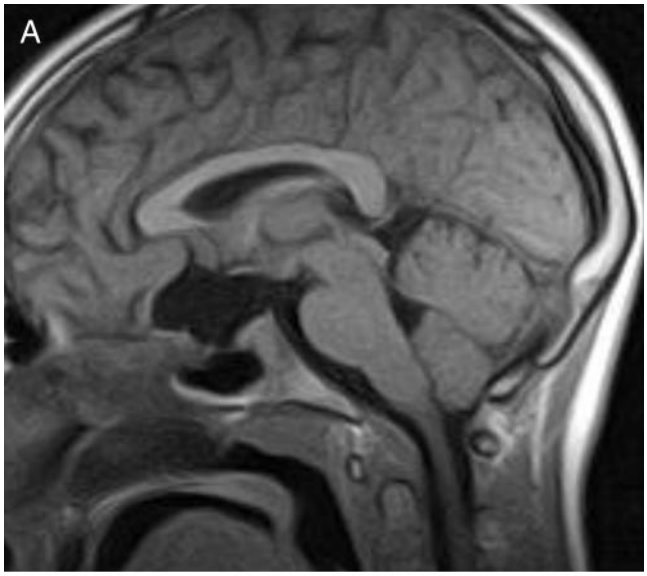
Routine magnetic resonance evaluation of the central nervous system occasionally reveals abnormalities that may be considered incidental findings. In Part 1, a number of examples of incidental findings were reviewed.[1] These included examples of meningioma, aneurysm, Chiari I malformation, Chiari I malformation with associated cervical spine syrinx cavity, empty sella, metastatic disease, cystic pineal gland, and lipoma of the corpus callosum.

There are other abnormalities that may be seen as incidental findings on routine examination, or examinations performed for specific indications, that will be reviewed in this article.

ARACHNOID CYST

Arachnoid cysts may be seen in any anatomic location. However, some locations are more common than others. Typical locations include the anterior temporal fossa, the parasellar region, and the cerebellopontine angle. They may also occur in other areas, such as over the cerebral convexity region. Arachnoid cysts are highly variable in size and configuration, although typically they exhibit a well-defined border. As the name implies, they contain cerebrospinal fluid and respond to MR pulse sequences similar to cerebrospinal fluid. They do not enhance after the infusion of contrast material. In the temporal lobe region, there may be associated mass effect, as well as focal atrophy of the temporal lobe. When located in the convexity region, there is frequently pressure erosion of the overlying bone. Arachnoid cysts are benign lesions. Very rarely, arachnoid cysts may be associated with hemorrhage into the cystic



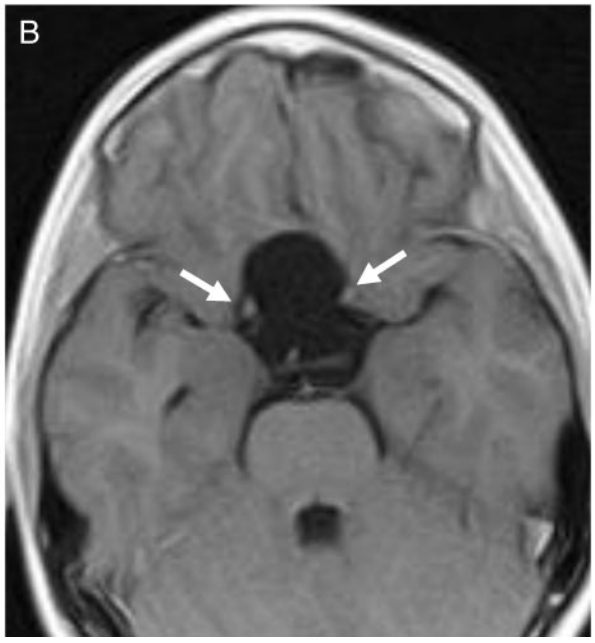


Figure 1A. *Suprasellar arachnoid cyst. Sagittal T1 weighted image reveals a CSF containing cyst in the suprasellar cistern. There is upward displacement of the optic chiasm.*

Figure 1B. *Suprasellar arachnoid cyst. Axial T1 weighted image reveals the arachnoid cyst. There is mild mass effect with lateral displacement of the carotid arteries bilaterally (arrows).*

portion in very young patients. In the majority of cases, no additional follow-up is needed (Figures 1A and 1B).

PITUITARY TUMORS

Headache is a common clinical complaint with pituitary tumors. Patients with headache may have a pituitary adenoma. The headache associated with pituitary adenoma is thought to be related to the pituitary tumor extending through the diaphragma sellae (Figures 2A and 2B). Adenomas that are larger than 1 cm are considered macro adenomas. Adenomas smaller than 1 cm are micro-adenomas. Pituitary adenomas typically enhance homogeneously post contrast. Occasionally, pituitary adenomas may be cystic and/or hemorrhagic. These patients will require additional follow-up and may require surgical intervention. Note that patients with micro-adenoma typically experience galactorrhea rather than headache.[3]

SINUSITIS

It is very common to see some degree of mucosal thickening in the paranasal sinuses on MR images of the brain. However, marked sinusitis may lead to additional complications such as headache, subdural or epidural empyema, or even brain abscess (Figure 3). The complications of sinusitis may lead to severe neurological deficit or even death. Severe sinusitis may require additional evaluation, such as high resolution CT scanning in the coronal projection. Sinus surgery with drainage may also be required. Other complications include the development of a mucocele. A mucocele results from blockage of the outlet of the sinus into the nasal cavity. The resultant fluid accumulation causes pressure expansion of the sinus. A pyocele results when there is infection within the expanded sinus.

VENOUS ANGIOMA

Venous angiomas are vascular lesions composed of multiple abnormally enlarged veins that drain into one enlarged vein (Figures 4A, 4B and 4C). They may occur in any part of the brain, including both the supra- and infra-tentorial compartments. They may rarely result in hemorrhage, which is more common in the posterior fossa than the supratentorial compartment. These venous angiomas are

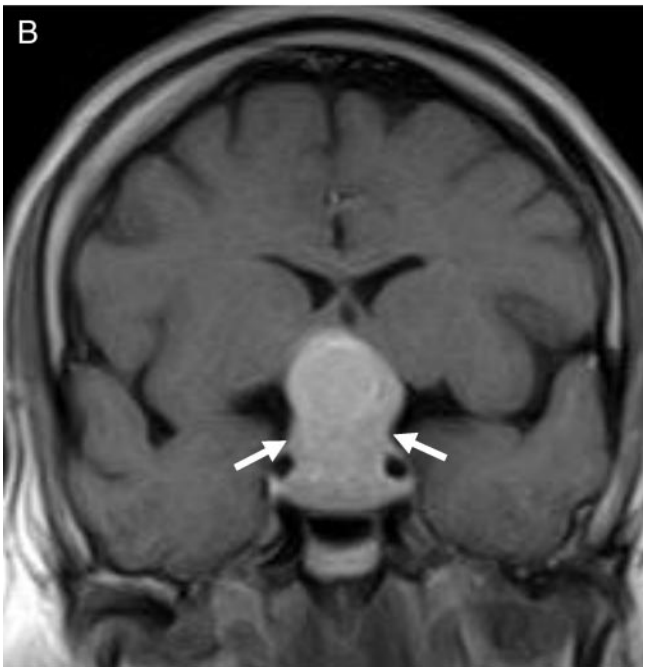


Figure 2A. *Pituitary macroadenoma with area of hemorrhage. Sagittal T1 weighted image reveals an intra- and suprasellar mass. There is a rounded area of increased signal intensity superiorly consistent with subacute hemorrhage. The sella is enlarged.*

Figure 2B. *Pituitary tumor. Coronal, post-contrast enhanced T1 weighted image reveals enhancement of the interior portion of the tumor, which obscures the upper areas of increased signal intensity hemorrhage. The area of narrowing of the tumor mass is at the level of the diaphragma sella (arrows).*

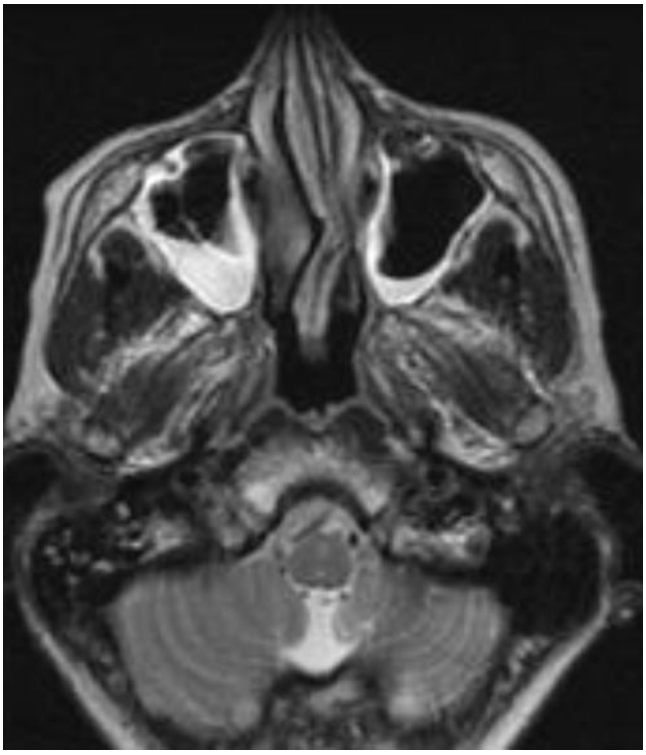


Figure 3. *Sinusitis. Axial T2 weighted image reveals increased signal intensity mucosal thickening involving the maxillary sinuses bilaterally, right side more than left. There are air/fluid levels in the dependent portions of the sinuses bilaterally, consistent with acute sinusitis.*

''no touch'' lesions and should not be operated upon. They may only be visible after the infusion of contrast material with either CT or MR imaging. No follow-up is needed if there are no complications.[4]

ARTERIOVENOUS MALFORMATIONS

These vascular malformations may be highly variable in size. They consist of enlarged arterial feeding vessels, a tangle of abnormal vessels, and enlarged draining veins. Arteriovenous malformations may occasionally be seen only post-contrast, although typically they exhibit areas of ''flow void'' on pre-contrast MR images. These lesions may be treated with watchful waiting, surgery, interventional neuroradiology, or gamma knife surgery if they are sufficiently small in size. Additional follow-up is required (Figures 5A and 5B).[5]

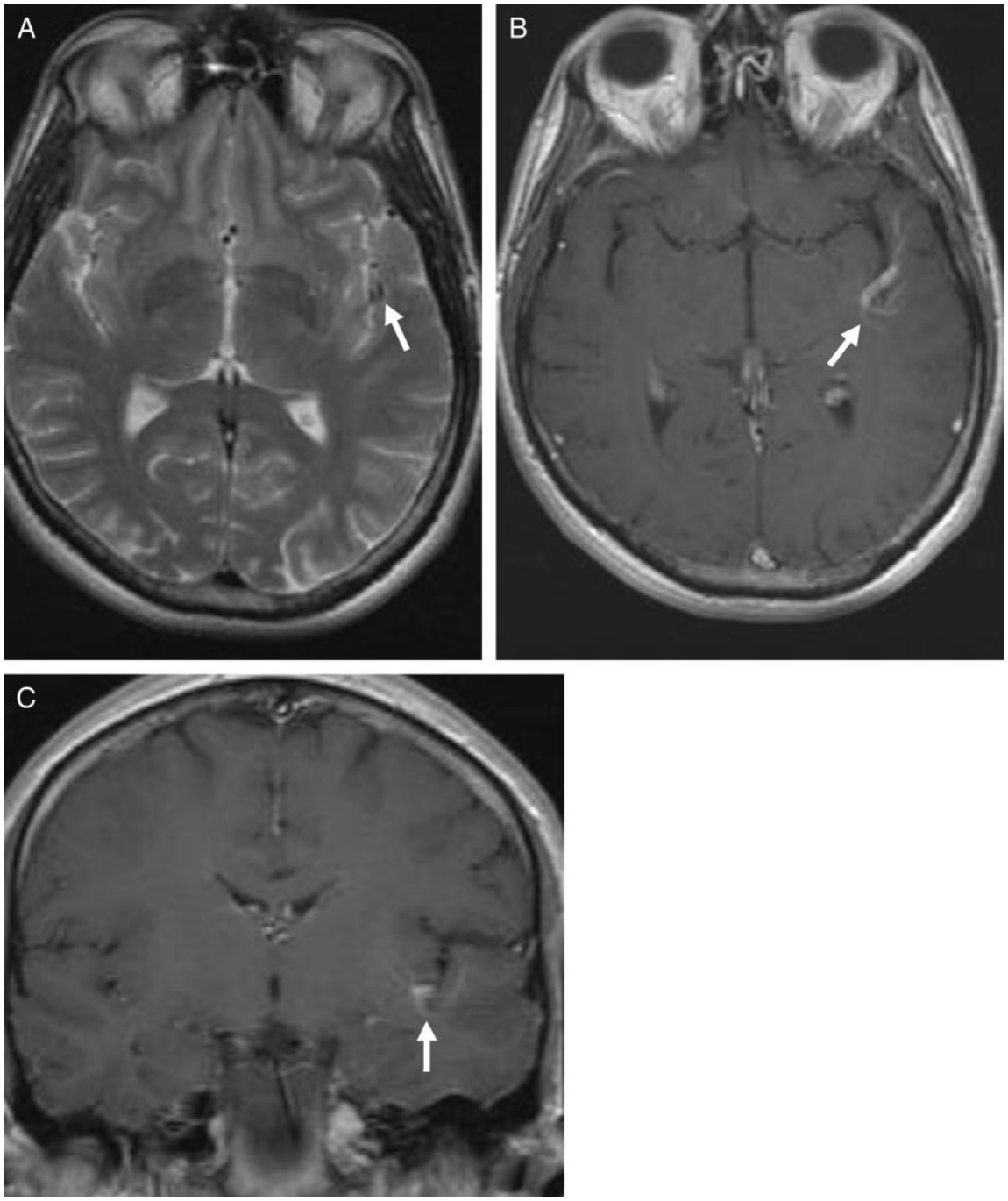


Figure 4A. *Venous angioma. Axial T2 weighted image reveals subtle areas of flow void in the region of the left sylvian fissure (arrow).*

Figure 4B. *Venous angioma. Axial, post contrast enhanced, T1 weighted image reveals multiple small, enlarged veins, which coalesce into one large vein (arrow).*

Figure 4C. *Venous angioma. Coronal, post contrast enhanced, T1 weighted image also reveals the venous angioma (arrow).*

AREAS OF ABNORMAL INCREASED SIGNAL INTENSITY

As noted in the Table, areas of increased signal intensity may be seen secondary to a wide range of clinical causes.

These areas may be of highly variable size, from punctate to large. Patient symptoms vary from headache to focal neurological deficit. In the presence of multiple sclerosis (MS), imaging abnormalities cover a wide range of appearances. Typically the lesions of MS are

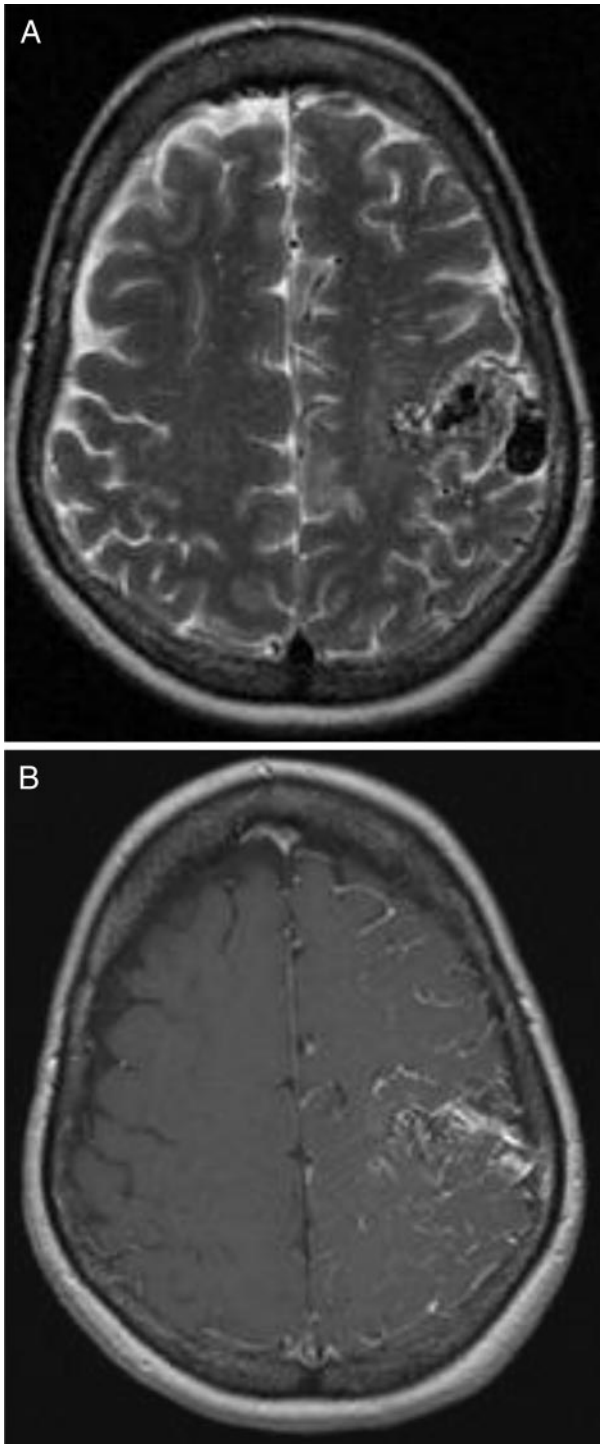


Figure 5A. *Arteriovenous malformation. Axial T2 weighted image reveals large, rounded areas of flow void secondary to enlarged draining veins. There are also multiple small curvilinear areas of flow void secondary to enlarged feeding arteries and draining veins.*

Figure 5B. *Arteriovenous malformation. Axial, contrast enhanced, T1 weighted image reveals multiple serpiginous and rounded areas of enhancement within the arteriovenous malformation, as well as multiple prominent veins over the entire left cerebral hemisphere.*

Table. Causes of Areas of Increased Signal Intensity

Small strokes/infarcts
Multiple infarcts
Binswinger disease
CADASIL
Epstein-Barr virus
Acute disseminated encephalomyelitis (ADEM), an autoimmune process
Multiple sclerosis
AIDS encephalomalacia
Old encephalitis
Sarcoidosis
Tuberculosis
Lyme-tick disease
West Nile virus
Progress multifocal leukoencephalopathy (PML)
Vasculopathy (previously called vasculitis)
Post-traumatic shearing injury
Sickle-cell disease with resulting infarcts

in the central nervous system where they may be located in the cortical, subcortical or periventricular white matter. MS plaques may also affect the corpus callosum. Plaques may also occur in the posterior fossa where involvement of the middle cerebellar peduncle is common. After the infusion of contrast material, there may be enhancement of the plaque if the plaque is undergoing active demyelination (Figures 6A, 6B and 6C). These patients often require additional evaluation of the cervical, and possibly the thoracic spinal cord with contrast enhancement. Multiple follow-up studies over long periods of time are required.

CADASIL

Cerebral autosomal dominant arteriopathy with sub-cortical infarcts and leukoencephalopathy (CADASIL) is the result of a hereditary small vessel vasculopathy caused by mutations in the NOTCH 3 gene on chromosome 19. CADASIL results in scattered areas of abnormal increase signal intensity, which are highly variable in appearance and occur in much younger individuals than those who are typically affected with arteriosclerotic disease (Figure 7). Additional follow-up im-

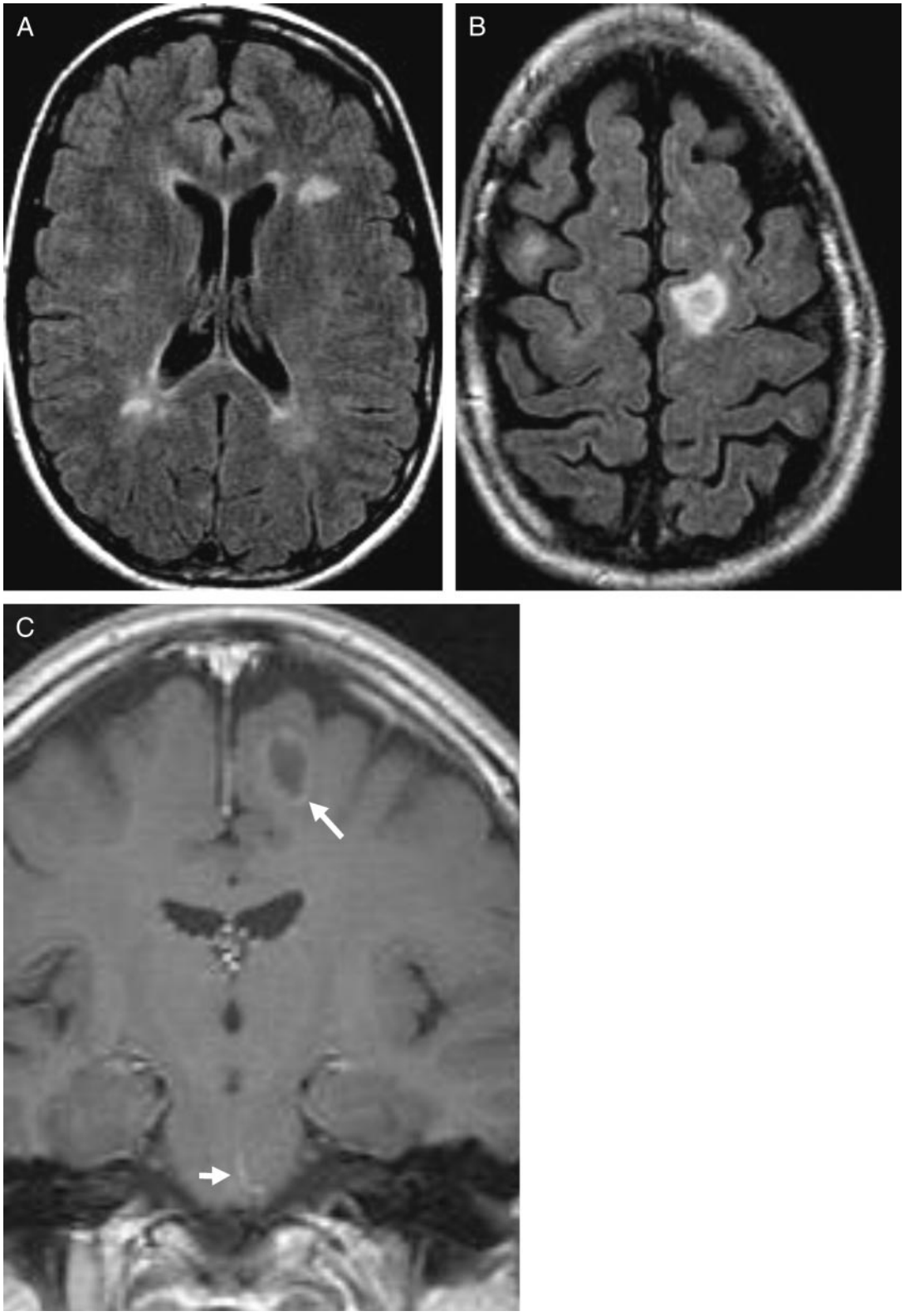


Figure 6A. *Multiple sclerosis with venous angioma of the pons. Axial T2 weighted image reveals multiple bilateral, areas of increased signal intensity secondary to the demyelinating plaques of multiple sclerosis.*

Figure 6B. *Axial FLAIR (FLuid Attenuating Inversion Recovery) images reveal a large, slightly irregularly marginated area of increased signal intensity in the left parietal lobe, as well as multiple, additional smaller areas of increased signal.*

Figure 6C. *Contrast enhanced coronal images exhibits a rim of enhancement surrounding the left parietal lesion (upper arrow) as well as a stelate area of enhancement in the pons (lower arrow) consistent with a small venous angioma.*

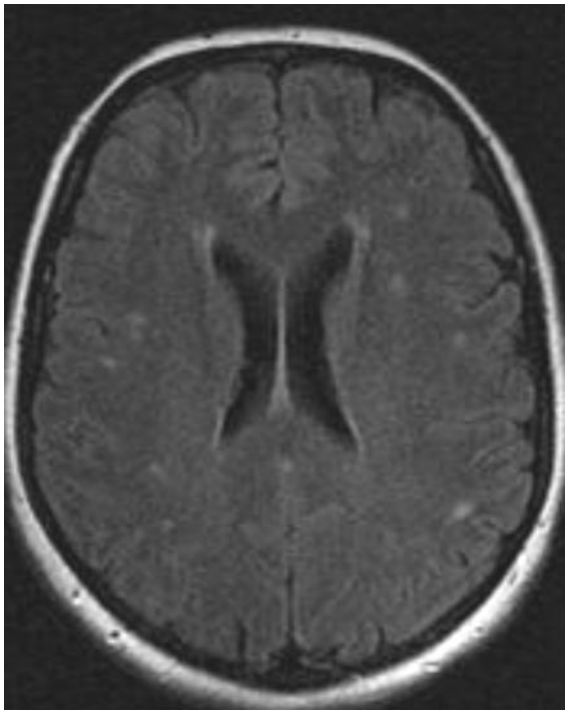


Figure 7. *CADASIL: Axial FLAIR image reveals multiple small rounded areas of increased signal intensity, which are non-space-occupying and consistent with areas of infarction.*

aging studies, as well as additional genetic evaluation, are required.[6]

SUBDURAL HEMATOMA

Either CT scanning or MR scanning may identify unsuspected, unanticipated subdural hematomas. In MR imaging, they typically occur as areas of crescent shaped increased signal intensity over the cerebral hemisphere (Figures 8A and 8B). Subdural hematomas are, however, widely variable in size and signal intensity depending upon the age of the hemorrhage. There is typically mass effect with compression of the lateral ventricles and adjacent cortical sulci.[7] Surgery is typically necessary, and with or without surgery, multiple follow-up studies are needed.

As mentioned in Part 1 of this article, incidental findings may or may not be significant. Each of these abnormalities needs to be evaluated in the clinical setting and in association with the patient's complaints.

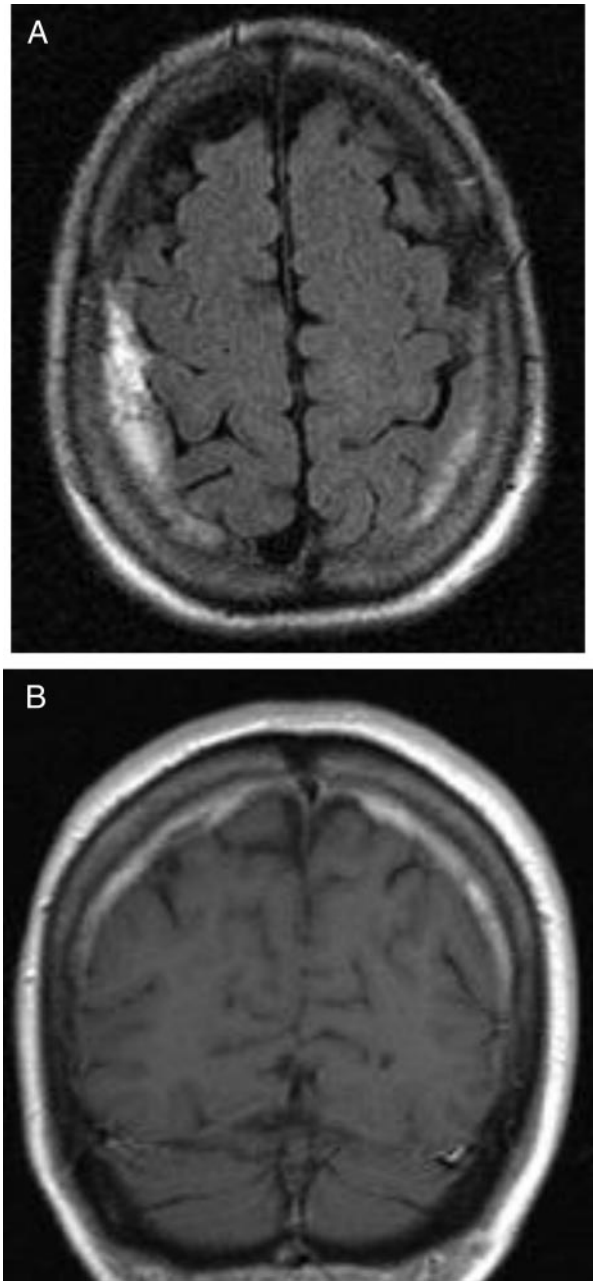


Figure 8A. *Subacute subdural hematoma. Axial FLAIR image reveals bilateral crescentic areas of increased signal intensity, right side slightly larger than the left side.*

Figure 8B. *Subdural hematoma. Coronal T1 weighted image reveals bilateral crescentic shaped areas of increased signal intensity consistent with subacute hemorrhage in the methemoglobin phase.*

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