Enhancing Intraventricular Atrial Mass

Anirudh Chaudhary, M.D., Alysha Vartevan, D.O.

1Department of Radiology, St. Joseph Hospital and Medical Center, Phoenix, AZ
2Clinical Instructor in Neuroradiology, University of Arizona College of Medicine, Phoenix, AZ

Case Presentation

A 46-year-old woman presented with a right-sided headache for 6 months, continuous during the last month. A review of systems was positive for nausea, intermittent numbness and weakness, and confusion during severe headaches. Physical examination showed no focal deficits and the patient was referred for an MRI of the brain (Figure 1).

FIGURE 1. Axial contrast-enhanced T1 MR image through lateral ventricles (A) demonstrates a large, lobulated, enhancing mass centered in the atria of the right lateral ventricle with leftward midline shift. Axial T2 fluid-attenuated inversion recovery (FLAIR) image (B) shows surrounding parenchymal edema. Axial contrast-enhanced T1 image more inferiorly (C) demonstrates entrapment and dilatation of the right lateral ventricle temporal horn with effacement of visualized basilar cisterns.
Key imaging finding
Enhancing intraventricular atrial mass

Differential Diagnosis
Intraventricular meningioma
Ependymoma
Choroid plexus tumors

Discussion
An intraventricular mass may present as an incidental finding or with signs of increased intracranial pressure, such as headache and nausea/vomiting. Intraventricular masses pose a challenge to the radiologist since the differential diagnosis is broad and many of the lesions share similar imaging characteristics. Knowledge of the patient’s age, gender, and any underlying conditions, as well as the location of the lesion, is crucial in suggesting reasonable differential considerations. Although the differential diagnosis for an enhancing intraventricular mass is quite extensive, meningiomas, ependymomas, and choroid plexus neoplasms are some of the more common lesions centered in the atria of the lateral ventricles.

Intraventricular Meningioma
Intraventricular meningiomas are relatively uncommon, accounting for 0.5% to 3.7% of all intracranial meningiomas. When located within the ventricles, the most common location is the atria or trigone of the lateral ventricle (as in the illustrated case), followed by the third, and rarely, fourth ventricles. Meningiomas are believed to arise from the arachnoid cap cells trapped in the choroid plexus. They are more common in middle-aged females with a 2:1 female-to-male ratio. Although meningiomas are uncommon in the pediatric population, up to 17% of intracranial pediatric meningiomas are intraventricular in location.

Intraventricular meningiomas are typically indolent low-grade tumors (WHO grade 1) and usually reach a large size before patients become symptomatic. However, anaplastic and atypical lesions have been reported. Metastases are uncommon, regardless of tumor grade.

On CT, meningiomas are iso- to hyperdense compared to gray matter, avidly enhance, and present as sharply demarcated lobular masses. Calcification is seen more frequently with intraventricular meningiomas compared with extraventricular dural-based lesions, occurring in approximately 50% of cases. On MRI, meningiomas present as iso- to hypointense on T1 and iso- to hyperintense on T2-weighted images. They tend to be highly vascular with avid enhancement. Focal or diffuse (less common) enlargement of the ventricles may be seen depending on the size of the lesion. Periventricular edema may be seen with larger lesions, possibly due to transepidermal edema or secretion of vascular endothelial growth factors, which induce edema. Reduced diffusion may be seen owing to the highly cellular nature of the meningiomas. MR spectroscopy often demonstrates elevated choline (CH); reduced N-acetylaspartate (NAA) and creatine; and variable lipid, lactate, and alanine.

Ependymoma
Ependymomas arise from ependymal cells lining the ventricular walls or presumed embryonic rests of ependymal tissue (for extraventricular lesions). They can be separated into two categories based on supratentorial or infratentorial location. Infratentorial lesions are more common, accounting for two-thirds of the cases, and occur more frequently in children. The most common location is the floor of the fourth ventricle. Ependymomas are known as “plastic” tumors because they often conform to the shape of the ventricle and “squeeze” through the foramen of Magendie (extension into cisterna magna) and Luschka (extension into cerebellopontine angles). Supratentorial ependymomas are more common in young adults with most being extraventricular in location. Supratentorial intraventricular ependymomas occur most frequently in the third, followed by lateral, ventricles.

Presenting symptoms depend on lesion location. The most common clinical symptoms include seizures, focal motor, and/or sensory impairment for supratentorial ependymomas and signs of increased intracranial pressure for infratentorial ependymomas. Infratentorial ependymomas tend to occur in infants and young children and have worse prognosis compared to supratentorial ependymomas.

On CT, ependymomas present as iso- to hypodense masses. Cystic areas and calcifications are common. On MRI, ependymomas are usually iso- to hypointense on T1 and iso- to hyperintense on T2-weighted images. There is variable signal within the cystic components due to proteinaceous content and/or hemorrhage. Variable enhancement is noted. “Blooming” may be present on susceptibility-weighted imaging secondary to calcium or blood products. Diffusion restriction is not present due to relative low cellularity. MR spectroscopy typically reveals an elevated NAA:Ch ratio.

Choroid Plexus Neoplasms
Choroid plexus neoplasms arise from choroid plexus epithelium and are one of the most common pediatric brain neoplasms in the first year of life. The most common location is the lateral ventricle (most often in the atrium), followed by the fourth and third ventricles. Approximately 5% of cases may occur at more than one location. The fourth ventricle location has a higher predilection for males (3:2 male-to-female ratio) and is more common in adults (although may occur at any age), while the
lateral ventricle location is much more common in the pediatric population.\textsuperscript{1,3}

Choroid plexus papillomas (CPPs) outnumber choroid plexus carcinomas (CPCs) by 5:1.\textsuperscript{1} CPPs are WHO grade I, atypical CPPs are WHO grade II, and CPCs are WHO grade III.\textsuperscript{1} CPPs are slow growing with rare malignant degeneration. The most common symptoms include macrocrania with bulging fontanelles in infants, as well as signs of increased intracranial pressure (headache, nausea, and vomiting).

Imaging alone often cannot distinguish between CPPs and CPCs. On CT, they appear as iso- to hyperdense lobulated masses (“cauliflower” like). Calcifications are common, occurring in approximately 25% of cases.\textsuperscript{2,3} Hydrocephalus is often present due to overproduction of cerebrospinal fluid (CSF) and/or decreased reabsorption of CSF by arachnoid granulations.\textsuperscript{1} CT angiography may demonstrate enlargement of the choroidal artery.\textsuperscript{1,3} A vascular pedicle is commonly seen. On MRI, lesions are iso- to hypointense on T1 and iso- to hyperintense on T2-weighted images. T2 fluid-attenuated inversion recovery (FLAIR) imaging often demonstrates periventricular edema. “Blooming” may be present on susceptibility-weighted imaging if calcium or hemorrhage are present. On MR spectroscopy, there is mildly elevated choline. Elevated myoinositol in CPPs may help in differentiating it from CPCs.\textsuperscript{3} The tumors are vascular and avidly enhance. Heterogeneous enhancement and invasion into the parenchyma suggests CPC over CPP.\textsuperscript{3} It is important to image the spine when CPCs are suspected to evaluate for CSF seeding.

**Diagnosis**

Intraventricular meningioma

**Summary**

Although the differential diagnosis for intraventricular masses is extensive, lesion location, patient age, and gender are key in narrowing the list of diagnostic considerations. When located in the atria of the lateral ventricle, meningiomas, ependymomas, and choroid plexus tumors are the most common etiologies. CT and MRI play complementary roles in characterizing these lesions, as well as in evaluating for intracranial complications.

**References**