Brain Tumors in the Neonate

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KEYWORDS
- Brain tumor • Neonate • Fetus • Computed tomography • Magnetic resonance imaging

KEY POINTS
- Neonatal brain tumors are rare and account for fewer than 2% of all pediatric brain tumors.
- Most brain tumors that present within the neonatal period (first 4 weeks after delivery) develop prenatally and may be diagnosed in utero with obstetric ultrasound imaging or fetal MR imaging.
- Teratoma, a subtype of germ cell tumors, is the most common brain tumor in neonates. On imaging, teratomas typically are well-defined, large, heterogeneous masses with contrast-enhancing solid portions, nonenhancing cystic portions, fatty tissue, and mineralization.
- Choroid plexus tumors are the second most common brain tumors found in neonates, commonly found in the lateral ventricle and often presenting with hydrocephalus. On MR imaging, they demonstrate a typical frondlike appearance, and avid contrast enhancement.
- Atypical teratoid/rhabdoid tumor (ATRT) is a primitive neoplasm that is a World Health Organization grade IV and is markedly aggressive with a universally dismal prognosis. The imaging appearance of ATRT is very similar to that of other embryonal tumors; however, ATRT often demonstrates a dramatically rapid growth pattern not seen with other tumors.

INTRODUCTION

The neonatal period is defined as the period of first 4 weeks after delivery. Brain tumors that present within the neonatal period are discussed in this article. Most of these develop prenatally and may be diagnosed in utero with obstetric ultrasound imaging or fetal MR imaging. Neonatal brain tumors are rare and represent 0.5% to 1.9% of all pediatric brain tumors. Several of the previously published series on neonatal brain tumors relied on data collected before the wide availability of neuroimaging with computed tomography (CT) or MR. The availability of high-resolution imaging during the fetal and neonatal periods makes the early diagnosis of these tumors possible, often at a subclinical stage. Advanced neuroimaging techniques have improved our understanding of the histologic and anatomic distribution and behavior of these tumors. With this improved understanding of neonatal brain tumors, it is likely that the previously published prevalence may not be a true reflection of the incidence of neonatal brain tumors.

Wakai and colleagues presented their categorization of congenital brain tumors to include brain tumor cases in infants presenting up to the first 2 months of life. Clearly tumors presenting at birth are congenital brain tumors. Thereafter, the confidence regarding the congenital or neonatal origin of brain tumors decreases with the increase in time between birth and presentation. More slowly growing brain tumors that develop during the neonatal period may not become apparent until the child is a year or older. Hence, several neonatal brain tumors that grow slowly may not be included...
in this category. In this article, we review imaging features of the brain tumors when they present in the neonatal age group.

The most recent update (2016) in the World Health Organization (WHO) classification of central nervous system (CNS) tumors has significantly changed the classification of a number of tumor families. This 2016 update has, for the first time, included molecular parameters into the diagnostic scheme. The most common neonatal brain tumor is teratoma, a subtype of germ cell tumors, followed by choroid plexus tumors. Another large group of neonatal brain tumors, the embryonal tumors, include embryonal tumors with multilayered rosettes (formerly known as primitive neuroectodermal tumor [PNET]), medulloblastomas, and atypical teratoid/rhabdoid tumors (ATRTs). ATRTs are a unique group of embryonal tumors that tend to occur in young children and neonates. The astrocytic tumors and tumors of neuronal and mixed neuronal-glial neuronal tumors, such as desmoplastic infantile astrocytomas (DIA) and gangliogliomas (DIG), are also typically found in the neonates. Meningeal tumors and hematopoietic tumors also can rarely present in the neonatal period. The more commonly occurring brain tumors in the neonate are presented in Box 1.

**CLINICAL PRESENTATION**

Clinical presentation of neonatal brain tumors varies depending on the type, size, and location of the tumor. Most common presenting signs are increasing head circumference, vomiting, and lethargy. A bulging fontanelle and setting-sun sign may also frequently be noted. Other presenting signs may include seizures, focal motor deficits, hemiparesis, cranial nerve palsy, and nystagmus. Cases diagnosed prenatally may have delivery complications including prolonged labor, fetal distress, and failure of labor progression, typically related to large head size.

**IMAGING**

Head ultrasound and unenhanced brain CT are the most common initial imaging modalities when neonatal brain tumors are suspected. In utero detection of congenital brain tumors is most often incidental, with screening or routine obstetric ultrasound, and better characterized with the increasing use of fetal MR imaging. The neonatal brain can be assessed with head ultrasound via the sonographic window created by the open fontanelles. Although detection of a mass is possible with ultrasound, cross-sectional imaging is required for further evaluation. CT imaging is quick and usually can be performed with swaddling of the neonate, without requiring sedation. Calcification and acute hemorrhage are easily detected with CT; however, CT scanning exposes the neonate to ionizing radiation. MR imaging with its multiplanar imaging capability, high signal-to-noise ratio, and superior ability to characterize tumors and their impact on surrounding structures, does not involve ionizing radiation. However, MR imaging may require sedation or, in some cases, general anesthesia. Advanced imaging sequences, such as perfusion, diffusion tensor imaging, and susceptibility weighted imaging can be extremely helpful in better characterizing the tumor types and their relationship(s) to eloquent brain regions. Volumetric acquisitions facilitate intraoperative imaging guidance, and can be performed with CT and MR imaging.

Regardless of the tumor type, the dominant imaging appearance of neonatal brain tumors is that of a large, heterogeneous-appearing mass, usually with hydrocephalus and macrocephaly.

**GERM CELL TUMORS**

Teratomas, a subtype of germ cell tumors are the most common brain tumor in neonates, accounting for approximately 33% to 50% of cases. Intracranial is the third most common location, after sacrococcygeal and cervico-facial. Teratomas arise from multipotent cells and, as a result, usually produce tissues that represent an admixture of 2 or more of the embryologic layers of ectoderm, mesoderm, and endoderm. A supratentorial location is seen in approximately in two-thirds of cases, most commonly associated with the
structures about the third ventricle; the pineal gland region is the leading site of origin, followed by the suprasellar region.7,9 Congenital teratomas also may involve the cerebral hemispheres more extensively.7

Mature (benign) teratomas are composed exclusively of well-differentiated, “adult-type” tissue elements. Mitotic activity is low or absent. The more common ectodermal components encountered in such tumors include skin, teeth, neural elements, and choroid plexus.12,13 Mesodermal representatives include cartilage, bone, fat, smooth and striated muscle, and choroid plexus (noting its dural embryologic origin).12 Cysts lined by respiratory or enteric epithelium account for endodermal elements and have been reported to contain thyroid, pancreatic, or hepatic tissue.12

Immature (malignant) teratomas contain incompletely differentiated components, resembling fetal tissue.7,14 Presence of any incompletely differentiated areas mandate classification of the lesion as immature, even a small component in an otherwise well-differentiated tumor.15–17 Some immature teratomas contain malignant cells of conventional somatic type. The most common of these are rhabdomyosarcoma and undifferentiated sarcoma.15–17 Production of alphafetoprotein by the glandular epithelium in an immature teratoma may result in elevated levels of this biomarker in the serum and cerebrospinal fluid (CSF). Increased serum carcinoembryonic antigen (CEA) also may be commonly found in patients with teratoma.16

On imaging, mature teratomas typically are well-defined, T1 and T2 heterogeneous masses with contrast-enhancing solid portions, nonenhancing cystic portions, fatty tissue, and mineralization. On CT they commonly appear as mixed density masses with any fatty components appearing hypodense; CT also has a high sensitivity for mineralization. This association of fat, mineralization, and heterogeneous solid and cystic tissue is highly suggestive of a teratoma.7,10 On MR images, mineralization may be more challenging to detect than on CT. However, with the use of T2 gradient echo and susceptibility weighted imaging, it is possible to reliably identify mineralization in teratomas on MR imaging. MR fat-suppression techniques and CT may be useful in differentiating fat from hemorrhage. Contrast enhancement is usually heterogeneous and is limited to the solid areas and along the walls of the cystic spaces7 (Fig. 1). Immature teratomas may show less well-defined margins and larger solid to cystic portion ratios. They are typically large and usually lacking in calcification and fat (Fig. 2). Immature teratomas are often larger than mature teratomas at presentation and infiltrate surrounding structures.7,10 Peritumoral edema is often observed around immature teratomas; this is usually absent with mature teratomas.7 CSF dissemination is common with immature teratomas.7 Imaging characteristics may suggest the type of teratoma; however, classification requires histologic examination.7 Intracranial teratomas are increasingly being diagnosed antenatally (Figs. 3–5).

The histologic subtype is the most important factor in predicting outcome. Mature teratomas are potentially curable by gross total resection. Prognosis with immature teratomas is generally poor, often due to extensive local invasion and/or CSF dissemination. However, the advent of improved adjuvant chemotherapy may improve the prognosis for the immature teratoma.

**CHOROID PLEXUS TUMORS**

Choroid plexus tumors are intraventricular, papillary neoplasms derived from the choroid plexus epithelium. Choroid plexus papillomas (CPP) are graded by WHO as grade I, atypical CPP as grade II, and the choroid plexus carcinoma (CPC) as grade III.6,18 Overall, the choroid plexus tumors comprise 0.3% to 0.6% of all brain tumors; however, they account for 2% to 4% of all brain tumors in children.7 Most choroid plexus tumors are CPPs and they are frequently congenital, as CPP has been reported to account for up to 42% of all neonatal brain tumors.7 In neonates, CPP is most commonly found in the lateral ventricle. Hydrocephalus is a common feature of CPP, and may be caused by mechanical obstruction of CSF pathways, due to adhesions resulting from hemorrhage, overproduction of CSF by the papilloma, or a combination thereof. CT imaging of choroid plexus tumors typically shows a large, isodense to hyperdense mass with well-delineated, lobulated margins and may be associated with foci of mineralization, and avid contrast enhancement. On MRI, they are generally T1 isointense and T2 hyperintense with well-delineated margins, a typical frondlike appearance, and avid contrast enhancement (Figs. 6 and 7).1 Differentiation between the subtypes of choroid plexus tumors on neuroimaging often is not possible and is usually determined on histopathological study (Fig. 8). It should be noted that, although histologically benign, CPP may seed the CSF due to its intraventricular location. The CPC is commonly associated with leptomeningeal spread of disease. Ventriculo-peritoneal shunt-related metastatic spread in the abdomen and extracranial metastases in the lung have rarely been described with CPC.
Fig. 1. Mature teratoma. Axial CT image (A) and axial T1 (B), axial T2 (C), and contrast-enhanced T1 axial with fat suppression (D) MR imaging demonstrates a large, heterogeneous, solid and cystic mass nearly completely filling the left hemi-calvarium (black arrows) containing fat components (thick white arrows) and mineralization (small white arrows). Gross pathologic specimen (E) of a teratoma with solid and cystic components containing hemorrhagic (white star) and fatty components (white arrow). (Courtesy of Dr Mariarita Santi, MD, Philadelphia, PA.)

Fig. 2. Immature teratoma. Axial CT images of a 1-week-old at brain window (A) and bone window (B) settings demonstrating a large teratoma (black star) involving the right supratentorial and infratentorial compartments of the brain with large exophytic component extending laterally and inferiorly into the cervical region. Extension into the right orbit (white arrow), infratemporal fossa, and skull base (black arrow) is also evident. Note destruction of the right petrous temporal bone (white star) and involvement of the right external auditory canal.
CPP has an excellent prognosis when successfully treated surgically, with a 5-year survival rate of up to 100%. Atypical histology with increased mitotic features, brain invasion, and dissemination or frank CPC portend a poorer prognosis.

EMBRYONAL TUMORS

Embryonal tumors comprise a heterogeneous group of tumors composed of undifferentiated or poorly differentiated neuro-epithelial cells that display divergent differentiation along neuronal, astrocytic, and ependymal lines. Among this group of embryonal tumors, the ATRTs and the medulloblastoma are most commonly encountered in the neonatal population. The new WHO classification of brain tumors has removed the term PNET from the diagnostic lexicon. Many of these tumors display amplification on the C19 MC region on chromosome 19. The presence of C19 MC amplification results in a diagnosis of embryonal tumor with multilayered rosettes (ETMR) C19MC-altered. In the absence of C19 MC amplification, a tumor with histologic features conforming to

![Fig. 3. Teratoma. Three-plane ([A] sagittal, [B] coronal, [C] axial) half-Fourier acquisition single-shot turbo spin-echo (HASTE) images from MR imaging of the brain of a 24-week fetus showing marked macrocephaly (black arrows) due to large, complex solid and cystic mass consistent with an intracranial teratoma occupying most of the cranial cavity (black star). Only thin bands of residual brain parenchyma can be seen at the periphery (white arrows).](image)

![Fig. 4. Mature teratoma. Axial (A) and coronal (B) HASTE images of fetal MR imaging study show a large solid and cystic teratoma (black star) involving right infratemporal fossa (white arrow), posterior fossa (black arrow) with exophytic extension extending laterally and inferiorly along the right neck (white star).](image)
**Fig. 5.** Mature teratoma. Axial T1 (A) and coronal postcontrast T1 (B) images from postnatal MR imaging (same patient as Fig. 4) demonstrating a large teratoma (black star) involving the right supratentorial and infratentorial compartments of the brain with large exophytic component extending laterally and inferiorly into the neck (white star). Extension into the right infratemporal fossa (white arrow) and skull base (black arrow) is also evident.

**Fig. 6.** CPP. Axial fluid-attenuated inversion recovery (A), postcontrast axial T1 with fat suppression (B), sagittal postcontrast T1 (C), and axial T2 gradient echo (D) MR images show a lobulated, homogeneously enhancing, mass in the atrium and occipital horn of the left lateral ventricle, in continuity with the choroid plexus (black star) containing calcifications/hemorrhage (white arrows), compatible with a choroid plexus papilloma. Secondary obstructive hydrocephalus is evident. Gross pathologic specimen (E) reveals the typical lobulated frond pattern. (Courtesy of Dr Mariarita Santi, CHOP.)
ETMR should be diagnosed as ETMR not otherwise specified (NOS).

A new 2016 WHO update on the terminology of CNS tumors has been released recently and has been adhered to in this review article.6

**Atypical Teratoid/Rhabdoid Tumor**

The ATRT is a primitive neoplasm that may arise in intra-axial or extra-axial spaces of the CNS as well as several other organs in the body. All are WHO grade IV tumors, being markedly aggressive with a universally dismal prognosis. Macroscopically, ATRTs are solid tumors with a variable-sized foci of cystic-necrotic change. On histopathology the presence of rhabdoid cells is the hallmark of these tumors. Other cell types may be found in association with rhabdoid cells, such as the primitive neuroectodermal cells, malignant mesenchymal cells, and malignant epithelium.19,20 Mutation or loss of the INI1/hSNF5 gene locus at chromosome 22 q11.2 is the genetic hallmark of the ATRT.7,21,22

Published large series of pediatric ATRT have shown a supratentorial preponderance.7 When supratentorial, they are usually located in the cerebral hemispheres, and less frequently intraventricular, suprasellar, or pineal. Infratentorial ATRTs can be located in the cerebellum, cerebellopontine angle, or brainstem; primary spinal ATRT is less common. CSF dissemination is frequent at presentation.

Neuroimaging of ATRT frequently demonstrates a large, heterogeneous mass with solid, cystic, and necrotic components, mineralization, and intralesional hemorrhage. The imaging appearance of ATRT is similar to that of other embryonal tumors; however, ATRT often demonstrates a dramatically rapid growth pattern not seen with other tumors.7,23 On unenhanced CT, solid portions demonstrate isodense to hyperdense attenuation relative to gray matter due to the presence of

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**Fig. 7.** CPP. Mass (white star) within the third ventricle as seen on axial noncontrast CT (A) and MR sagittal T2 (B) and axial postcontrast T1 (C).

**Fig. 8.** CPC. Axial noncontrast CT (A) and axial T2 (B) and axial postcontrast T1 with fat suppression (C) MR imaging reveals a homogeneously enhancing lobulated mass (black star) within the atrium and occipital horn of the left lateral ventricle along with a large cystic component (white arrow).
tightly packed cells with high nuclear-to-cytoplasmic ratio. Contrast enhancement is variable and heterogeneous. Mineralization is often present. On MRI, ATRTs are isointense to hypointense on unenhanced T1-weighted images relative to gray matter, and generally isointense to hypointense on T2-weighted images, in keeping with the high nuclear-to-cytoplasmic ratio, and low free water content within the rhabdoid cells. Cystic-necrotic portions are well demonstrated on MRI. Contrast enhancement is heterogeneous, similar to that seen on CT, and can be mild and/or only involve portions of the solid mass. Solid portions nearly always demonstrate diffusion restriction24 (Fig. 9). Contrast-enhanced MRI of the entire cranio-spinal axis is mandated in ATRT evaluation to assess for leptomeningeal spread of disease, which is usually present in approximately 33% of cases at presentation7 (Fig. 10). Multiple sites of synchronous ATRTs suggest an underlying germ-line mutation.7

**Medulloblastoma**

In children, medulloblastomas are predominantly cerebellar, commonly arising from the vermis; however,7 in neonates medulloblastomas are more often supratentorial.25 Other sites in neonates include the pineal region, the suprasellar region, and spinal cord. Regardless of location, the imaging features of CNS medulloblastomas are similar. They are isodense to hyperdense on CT due to the tightly packed, small, round blue cells. They may appear as entirely solid masses or may contain cystic or necrotic areas. Mineralization and/or hemorrhage may be present (Fig. 11). On MRI, medulloblastomas are hypointense to gray matter on T1-weighted images, and isointense to hypointense on T2-weighted images with any cystic or necrotic areas appearing T2 hyperintense. Contrast enhancement is usually present within the solid portions. Diffusion restriction is a hallmark of medulloblastomas7 (see Fig. 11; Fig. 12). CSF dissemination is common; hence, MRI of the entire cranio-spinal axis is warranted.7 A more detailed description of medulloblastomas can be found in other articles of this issue.

**Embryonal Tumor with Multilayered Rosettes**

Formerly known as PNET, ETMRs are typically seen in children younger than 4 years and may be either supratentorial or located in the posterior fossa. These are very aggressive lesions with dismal prognosis.

**ASTROCYTIC TUMORS**

Neuroepithelial tumors constitute a large group of neonatal brain tumors. Most of these are glial in origin, most commonly astrocytomas.5 As with many of the neonatal tumors, a supratentorial location is common, including the suprasellar/hypothalamic region. Astrocytomas also may involve the cerebral hemispheres, optic nerves, thalami, mesencephalon, and the pons. Neonatal astrocytomas involving the cerebral hemisphere are often very large at presentation and commonly involve more than one lobe.2,26 The imaging appearance of astrocytoma is typically that of a solid or mixed solid and cystic mass, generally hypodense on unenhanced CT with

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**Fig. 9.** ATRT. Heterogeneous predominantly solid mass (black star) with patchy enhancement and diffusion restriction (white arrow) as seen on sagittal T2 (A), sagittal postcontrast T1 (B), and axial diffusion (C) and apparent diffusion coefficient (ADC) map (D) in a 4-week-old girl.
variable contrast enhancement. MR imaging of astrocytoma usually demonstrates T1 hypointensity, T2 hyperintensity, and variable contrast enhancement (Fig. 13). Special mention must be made of astrocytomas, which may be seen in the setting of tuberous sclerosis complex (TSC), along with other stigmata of TSC, which include cortical tubers and...
subependymal nodules, and the subependymal giant cell astrocytoma (SEGA), also known as mixed giant cell tumors, typically located at the foramina of Monro (Fig. 14). The SEGA can block the flow of CSF, resulting in ventricular trapping and hydrocephalus. It is possible to now identify the SEGAs on antenatal MR imaging, although prenatal and neonatal obstructive hydrocephalus in TSC is rare. Use of mammalian target of Rapamycin pathway inhibitors, such as Everolimus, has revolutionized the care of patients with TSC; successful treatment of neonatal SEGA and non-CNS tumors has been reported.28

Hamartomas are a group of benign tumors that represent heterotopic accumulations of normal brain tissue. Common locations include
intraventricular and hypothalamic (Fig. 15). Hamartomas may be detected on antenatal or neonatal brain imaging. Hypothalamic hamartoma is the primary feature of Pallister-Hall syndrome, with other major manifestations including polydactyly, dysplastic nails, bifid epiglottis, imperforate anus, renal anomalies, pituitary dysplasia, and hypopituitarism (Fig. 16).29

**NEURONAL AND MIXED NEURONAL-GLIAL TUMORS**

DIAs and DIGs are the most common among the “neuronal and mixed neuronal-glial tumor” group that are found in the neonatal population. DIAs and DIGs are large intracranial cystic tumors of infancy that involve the superficial cerebral cortex and leptomeninges, often also being attached to the dura via a desmoplastic reaction.30 DIAs and DIGs are classified as WHO grade I. The DIG is almost exclusively found in infants younger than 6 months and, in most cases, is a congenital tumor. The histopathology of the DIG differs from the DIA by the presence of a neural component with glial differentiation; however, both have similar clinical and neuroimaging features, and favorable prognoses. These tumors typically are supratentorial and involve more than one lobe, most commonly the frontal and parietal, followed by the temporal and, least frequently, the occipital lobe. On CT, DIAs and DIGs are seen as large, cystic, hypodense masses with solid isodense or slightly hyperdense superficial solid components extending to the overlying meninges and demonstrate contrast enhancement of the solid portion.26,30,31 MR imaging demonstrates

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Fig. 13. Pilocytic astrocytoma. Axial image from noncontrast CT (A) and axial T2 (B) and sagittal postcontrast T1 (C) MR imaging reveals a lobulated, midline, butterfly-shaped mass (black star) with nearly homogeneous contrast enhancement centered at the hypothalamic chiasmatic region.

Fig. 14. Tuberous sclerosis complex. Axial T2 HASTE images from fetal MR imaging (A) and axial T2 (B) and postcontrast axial T1 (C) from postnatal MR imaging reveal a T2 hypointense mass with contrast enhancement at the right foramen of Monro (black star) along with multiple enhancing subependymal nodules as well as radial migration lines (white arrows) and cortical tubers (white star).
hypointensity of the cystic components and isointensity of solid components on T1-weighted imaging. On T2-weighted imaging the cystic components are hyperintense and the solid portion is heterogeneously hyperintense. Edema is usually absent or disproportionately less compared with the size of the mass (Figs. 17 and 18).

Fig. 15. Hypothalamic hamartoma. Nonenhancing round mass in the hypothalamus (black star) with signal characteristics similar to the brain parenchyma as seen on sagittal T1 (A), axial T2 (B), and sagittal postcontrast T1 (C) MR imaging in this 7-day-old. Note the ectopic location of the neurohypophysis (white arrow) at the superior infundibular/anterior hypothalamic location, and the hypoplastic pituitary gland.

Fig. 16. Pallister-Hall syndrome. Large hypothalamic hamartoma (black star) as seen on fetal MR imaging study sagittal T2 HASTE (A) and on postnatal MR imaging (sagittal T1 [B], axial T2 [C]). Radiographs of the hands (D) reveal bilateral metacarpal syndactyly.
**Fig. 17.** DIA. Mixed signal mass with small solid and large cystic locules almost occupying the entire right supratentorial brain on MR imaging in this 6-week-old on axial T2 (A), postcontrast axial T1 with fat suppression (B), and sagittal T1 (C). Mass was seen to be largely nonenhancing with minimal enhancement along the margin of the cystic locules.

**Fig. 18.** DIG. Initially diagnosed at 4 weeks of life as seen here on follow-up MR imaging on axial (A) and coronal T2 (B), and axial postcontrast T1 with fat suppression (C) with contrast-enhancing solid and large nonenhancing cystic components.

**Fig. 19.** Cavernous malformation. Axial noncontrast CT (A) and sagittal T2 (B) and axial postcontrast T1 with fat suppression (C). MR imaging reveals a hyperdense mass (white arrow) on CT within the dorsal pons with a slightly heterogeneous appearance on T2-weighted imaging and homogeneous contrast enhancement.
Several entities can mimic the appearance of a neonatal brain tumor on imaging. Moderate to large-size cavernous malformations, hemangiomas, and hemangioendotheliomas can sometimes be mistaken for a neoplasm (Fig. 19). Parenchymal hemorrhage can be a perplexing imaging feature because hemorrhage can mask an underlying brain tumor or vascular malformation (Fig. 20). Among the neonatal brain tumors, parenchymal hemorrhage has been commonly seen as a presenting feature of the medulloblastoma subtype of embryonal tumors. Follow-up imaging, and in some cases vascular imaging, may be necessary to make the distinction between an underlying tumor and a vascular malformation.

SUMMARY

Neuroimaging features play an important role in the early detection and characterization of antenatal and neonatal brain tumors. Imaging studies can assess the morphology of the tumor, hydrocephalus, local invasion, and distant spread. A reasonable differential diagnosis of the most likely tumor types can be derived from imaging characteristics. The practicing radiologist should be familiar with the characteristic imaging features of the more common neonatal brain tumors.

REFERENCES


Fig. 20. Hematoma. When large, a hematoma can mimic a brain tumor, as seen in this MR image (sagittal T1 [A], axial T2 [B]) performed on a 6-day-old with a large posterior fossa hemorrhage. No underlying mass or vascular malformation was present.


