Section XI – Neuroradiology

214. You are shown a bone window axial CT image (Figure 1) obtained from a newborn. What is the MOST LIKELY diagnosis?

A. Bony choanal atresia
B. **Membranous choanal atresia**
C. Piriform aperture stenosis
D. Choanal stenosis

**Rationale:**
A. This is membranous choanal atresia
B. The choana is narrowed and is obliterated with a soft tissue plug.
C. This is a narrowing of the anterior nasal opening.
D. The choana would be narrowed, but would have a patent air filled passage.
215. You are shown an axial FLAIR image (Figure 2) and diffusion-weighted images (Figures 3 and 4) of a 70-year-old woman with rapidly progressive cognitive decline and myoclonic jerks. What is the MOST LIKELY diagnosis?

A. Acute bilateral middle cerebral artery (MCA) infarctions
B. Creutzfeldt-Jakob disease (CJD)
C. Thrombosis of the deep venous system with venous infarction
D. Hypoxic-ischemic encephalopathy (HIE)

Findings:
There is symmetric bilateral restricted diffusion in the striatum and paramedian frontal cortex with sparing of the thalamus, internal capsule and globus pallidus.

Rationale:
A. There is symmetric bilateral restricted diffusion in the striatum and paramedian frontal cortex with sparing of the internal capsule and globus pallidus. The abnormality involves portions of two vascular territories, anterior and middle cerebral arteries, and would therefore be atypical for acute infarction.
B. There is symmetric bilateral restricted diffusion in the striatum and paramedian frontal cortex with sparing of the internal capsule and globus pallidus. These findings are characteristic of Creutzfeldt-Jakob disease (CJD). DWI has been reported to be more sensitive than T2W or FLAIR imaging for the early diagnosis of CJD.
C. Deep venous thrombosis typically results in edema and possibly early reversible restricted diffusion in the thalamus bilaterally. The thalamus is relatively spared in this case.
D. There is symmetric bilateral restricted diffusion in the striatum and paramedian frontal cortex with sparing of the thalamus, internal capsule and globus pallidus. While these findings could also be seen in hypoxic-ischemic encephalopathy (HIE), the clinical history of progressive cognitive decline and myoclonic jerks does not support this diagnosis.
216. You are shown a noncontrast CT image (Figure 5), T1-weighted image (Figure 6), and GRE MR image (Figure 7) of a 76-year-old woman presenting with acute headache and confusion. What is the MOST LIKELY diagnosis?

A. Traumatic parenchymal contusion
B. Hemorrhagic metastasis
C. Hemorrhagic infarction
D. Cerebral amyloid angiopathy

**Rationale:**
A. There is an acute hematoma in the right frontal lobe with changes of chronic microhemorrhage remote from the acute hematoma in both hemispheres at the gray-white matter junction. These findings are most consistent with a diagnosis of cerebral amyloid angiopathy in an elderly patient. There was no clinical history of trauma and there are no other post-traumatic abnormalities such as scalp hematoma or subarachnoid hemorrhage.
B. There is acute hemorrhage in the right frontal lobe with relatively little edema as would be expected with a metastasis. The patient also has no clinical history of a primary tumor.
C. Hemorrhagic transformation of acute infarction typically has a delayed onset of 24-48 hours after ictus secondary to reperfusion following lysis of obstructing vascular thrombus. This patient presented acutely with a right frontal lobe hemorrhage.
D. These findings are most consistent with a diagnosis of cerebral amyloid angiopathy in an elderly patient.
217. A 39-year-old woman presents with clumsiness in her hands, a numb feeling in her left arm, and increasing gait difficulties. Based on the MR images (Figures 8 and 9) and CT images (Figures 10 and 11), what is the MOST LIKELY diagnosis?

A. Sequestered disc herniation  
B. OPLL  
C. Epidural hematoma  
D. DISH

Findings:
There is ossification of the posterior longitudinal ligament over 4 contiguous levels and to a lesser extent of the anterior longitudinal and transverse ligaments, best seen on the CT exam. Ossification is difficult to confirm on MRI, but is suggested by the presence of fatty marrow elements on the T1-weighted image. The T2-weighted sagittal MRI best demonstrates narrowing of the spinal canal and cord compression.

Rationale:
A: A sequestered disc herniation would involve a single disc level. The abnormality shown extends over multiple contiguous vertebral levels.
B: There is ossification of the posterior longitudinal ligament (OPLL) over 4 contiguous levels, best seen on the CT exam. Ossification is difficult to confirm on MRI in the absence of fatty bone marrow elements. However, MRI best demonstrates narrowing of the spinal canal and cord compression.
C: The density of the abnormality on CT is not characteristic of a hematoma. It is characteristic of dense calcification or ossification and is confined to the posterior longitudinal ligament.
D: Diffuse idiopathic skeletal hyperostosis (DISH) is characterized by flowing paravertebral ossification over at least 4 contiguous levels and primarily involving the anterior longitudinal ligament. This case demonstrates involvement of 4 contiguous levels but primarily involves the posterior longitudinal ligament.
218. You are shown a coronal image (Figure 12) from a CT examination of the temporal bone. What is the BEST diagnosis?
   A. Acute otitis media
   **B. Acquired cholesteatoma**
   C. Congenital cholesteatoma
   D. Glomus tympanicum

**Rationale:**
A: The scutum is blunted and the tympanic membrane is thickened and retracted implying a chronic process.
B: Blunted scutum, opacified Prussak's space, thick retracted TM good clues in this case
C: The majority of cholesteatomas are acquired, not congenital.
D: Better location would be on the cochlear promontory.
219. A 40-year-old woman presents with acute right leg pain. You are shown MR images of the lumbar spine (Figures 13-16). Which nerve root is compressed by the disc herniation?

A. Right L4  
B. Left L4  
C. **Right L5**  
D. Right S1

**Findings:**
There is an epidural mass at the L4/5 disc space with compression of the right L5 nerve root in the subarticular recess.

**Rationale:**
A: The right L4 nerve root has already entered the neuroforamen and is not compressed by the disc herniation.
B: The disc herniation is on the right side and is not compressing left nerve roots.
C: The disc herniation is compressing the right L5 nerve root as it traverses the subarticular recess.
D: The right S1 nerve root leaves the thecal sac inferior to the disc herniation. It is not compressed by the disc herniation.
220. A 30-year-old man presents with neck and right arm pain. You are shown MR images of the cervical spine (Figures 17-19). What is the MOST LIKELY diagnosis?

A. Meningioma  
B. Ependymoma  
C. Hemangioblastoma  
D. Schwannoma

**Findings:**
A large intra- and extra-dural mass is present at the level of C3/4. The mass extends into the right neural foramen, which is enlarged. The mass is extramedullary and there is compression of the spinal cord. The mass shows intense heterogeneous contrast enhancement.

**Rationale:**
A: Meningiomas typically occur in the thoracic spine in older patients. They are extramedullary masses, but the extension through the neural foramen would be unusual.
B: Ependymoma of the cervical spine is usually an intramedullary mass. It typically shows enhancement, but the spinal cord will be enlarged rather than compressed.
C: Hemangioblastoma is an intramedullary mass. It is most commonly found in the cerebellum but may also occur in the spinal cord, particularly in patients with von Hippel-Lindau disease.
D: A dumbbell shaped intra- and extra-dural mass is the classic appearance of Schwannoma. When large, they may result in spinal cord compression, as in this case. This tumor grows slowly, which can result in the remodeling and enlargement of the neural foramen as seen in this case.
221. You are shown axial T2-weighted and diffusion-weighted MR images (Figures 20 and 21) of a 5-year-old girl. What is the BEST diagnosis?

A. Ependymoma
B. Medulloblastoma
C. Pilocytic astrocytoma
D. Choroid plexus papilloma

**Rationale:**
A: The posterior fossa mass has features suggestive of medulloblastoma. Ependymomas are usually more heterogenous often containing cysts and calcification. They are less common than posterior fossa medulloblastomas in children.

B: Midline cerebellar mass posterior to the fourth ventricle that is densely cellular given the appearance on the diffusion and the T2 weighted sequence is consistent with a medulloblastoma. Evaluation of the entire neural axis should be performed prior to institution of therapy.

C: These lesions are usually located laterally, are cystic and have an enhancing mural nodule. Usually older age group than kids with medulloblastoma.

D: More common in the atria of the lateral ventricle in a young child. Most common in children less than 1 year of age. These lesion densely enhance and present with hydrocephalus.
222. You are shown two axial images (Figures 22 and 23) from a CT scan performed on a 4-year-old child. What is the MOST LIKELY diagnosis?

A. Alobar holoprosencephaly  
B. Severe hydrocephalus  
C. Hydranencephaly  
D. Bilateral open-lip schizencephaly

Rationale:  
A: Incorrect.  
B: Incorrect.  
C: The most likely diagnosis is Hydranencephaly. There is an absent cerebrum with a CSF filled cranial vault. The falx cerebri and posterior fossa structures are intact. These are the findings of Hydranencephaly. Alobar Holoprosencephaly would have fused midline structures, absence of the falx, and a cerebral mantle around a monoventricle. Severe hydrocephalus would demonstrate a thin peripheral cortical mantle compressed against the inner table. Bilateral open-lip schizencephaly would have MCA distribution trans-mantle gray matter lined clefts, i.e. some cortical mantle would be evident.  
D: Incorrect.
223. You are shown a sagittal noncontrast T1-weighted image (Figure 24) and an axial CT image (Figure 25) performed on a 15-year-old male patient. What is the MOST LIKELY diagnosis?

   A. Germinoma  
   B. Teratoma  
   C. Pineoblastoma  
   D. Pineal cyst 

**Rationale:**

A: This pineal region mass is heterogeneous with cystic areas as well as calcification and fat attenuation. These features are typical of teratoma. Teratoma is the second most common pineal tumor in children of all ages with peak incidence in the second decade. Germinoma tends to be more homogeneous, high CT attenuation prior to contrast, and strong enhancement post contrast.

B: The best diagnosis is Teratoma. This pineal region mass is heterogeneous with cystic areas as well as calcification and fat attenuation. These features are typical of teratoma. Teratoma is the second most common pineal tumor in children of all ages with peak incidence in the second decade. Germinoma tends to be more homogeneous, high CT attenuation prior to contrast, and strong enhancement post contrast. Pineoblastoma may be heterogeneous, have “exploded” calcifications, and hemorrhage – however they do not contain fat. Pineal cysts are typically of CSF signal and attenuation in the absence of hemorrhage. They would not have a solid component with fat and calcification.

C: This pineal region mass is heterogeneous with cystic areas as well as calcification and fat attenuation. These features are typical of teratoma. Teratoma is the second most common pineal tumor in children of all ages with peak incidence in the second decade. Pineoblastoma may be heterogeneous, have “exploded” calcifications, and hemorrhage – however they do not contain fat.

D: This pineal region mass is heterogeneous with cystic areas as well as calcification and fat attenuation. These features are typical of teratoma. Teratoma is the second most common pineal tumor in children of all ages with peak incidence in the second decade. Pineal cysts are typically of CSF signal and attenuation in the absence of hemorrhage. They would not have a solid component with fat and calcification.
224. Which statement about moyamoya disease is CORRECT?

A. Children tend to present with subarachnoid and intraventricular hemorrhage.
B. Cervical segment internal carotid artery occlusion or stenosis is common.
C. **It has a known association with sickle cell disease.**
D. The lenticulostriate vasculature often occludes over time.

**Rationale:**
A: Children tend to present with TIAs and strokes.
B: Supraclinoid segment internal carotid artery occlusion or stenosis is characteristic.
C: Correct.
D: The lenticulostriate vessels hypertrophy and serve as collateral vessels with moya moya syndrome.

225. Concerning schwannomas in the internal auditory canal, which of the following statements is TRUE?

A. They arise from the cochlear division of the eighth cranial nerve.
B. **They are the most common lesions found in patients with unilateral sensorineural hearing loss.**
C. They are the second most common cerebellopontine angle mass after meningioma.
D. If bilateral, they likely reflect neurofibromatosis type 1.

**Rationale:**
A: Arise from the vestibular division of the eighth cranial nerve.
B: Correct.
C: Acoustic schwannoma is the most common CP angle mass.
D: Bilateral in NF-2, not NF-1.

226. Regarding metastases to the brain, which of the following is TRUE?

A. Patients present with solitary metastases in less than 10% of cases.
B. Metastases often have ill-defined borders and scant vasogenic edema.
C. **Cortical metastases are difficult to detect on T2-weighted imaging and therefore administration of contrast is essential.**
D. Metastases typically occur in deep cerebral white matter.

**Rationale:**
A: Patients present with solitary metastases in approximately 50% of cases.
B: Metastases, in contrast to primary brain tumors, usually well-defined borders and moderate vasogenic edema, often disproportionate to the size of the lesion.
C: Cortical metastases often have little associated edema and are therefore difficult to detect on T2WI. Administration of contrast is essential to detect cortical lesions.
D: Metastases typically occur at the gray-white matter junction because of the small caliber of the vessels in this region.
227. What is the primary benefit in performing head CT using a detector configuration of 16 *0.625 mm instead of 16 *1.25 mm?

A. More anatomical coverage obtained per tube rotation
B. **Improved z-axis spatial resolution**
C. Decrease in beam-hardening artifact
D. Decrease in radiation dose

**Rationale:**
A: 16*0.625 mm implies 10 mm coverage and is less than 20 mm coverage (16*1.25 mm) and therefore less anatomical coverage is obtained per tube rotation.
B: A 0.625mm detector element (z-axis collimation) will provide better resolution of fine detail structures than a 1.25mm detector element due to the decrease in partial volume averaging with the thinner detector element.
C: Detector configuration has no effect on the amount of beam hardening in a given image
D: In fact, the radiation dose is slightly higher with thin (0.625 mm) detector configuration compared to thick (1.25 mm) detector configuration and therefore may yield higher dose.

228. Which of the following is MOST LIKELY to cause widening of the disc space?

A. **Sickle cell disease**
B. Calcium pyrophosphate crystal deposition disease (CPPD)
C. Discitis and osteomyelitis
D. Neuropathic osteoarthropathy

**Rationale:**
A: The biconcavity seen at the superior and inferior end plates of osteoporotic vertebral bodies in sickle cell disease resembles the appearance of the fish spine leading to the term “fish” vertebrae. The intervertebral disc spaces have a widened appearance similar to that of the “fish mouth.”
B: Calcium pyrophosphate crystals deposit in the cartilaginous endplate and intervertebral discs causing disc space narrowing and calcification as well as sclerosis of the adjacent vertebral body endplate margins.
C: Early phases of discitis and osteomyelitis are characterized by signal alteration and enhancement in the disc space and adjacent vertebral endplates. Without treatment, disc space and bony destruction will occur.
D: Loss of sensation and proprioception causes repetitive traumatic injury. This leads to sclerosis, osteophytosis and fragmentation of vertebral body endplates and to narrowing of the intervertebral endplates.
229. Which of the following is TRUE regarding imaging in acute infarction?
   A. Nonenhanced CT does not demonstrate changes in the first 6 hours after onset.
   B. Mass effect peaks between 7 and 10 days.
   C. Variable nonstandard window width and level settings on PACS facilitate detection of early edema.
   D. Enhancement is common in the first 3 days after ictus.

**Rationale:**
A: Within the first 6 hours after onset of acute infarction, edema can be seen as obscuration of the contrast difference between gray and white matter in the cortex and insular ribbon and at the junction of the lentiform nucleus and internal capsule.
B: Mass effect peaks between 3 and 5 days and usually resolves in 2 to 4 weeks.
C: Variable nonstandard window width (approximately 8) and level (approximately 32) settings on PACS accentuate the gray white matter contrast difference facilitating the detection of early edema.
D: Enhancement is uncommon in the first 3 days after ictus. Early enhancement may indicate spontaneous or iatrogenic clot lysis and reperfusion into an area of infarcted brain.

230. In the evaluation of spinal compression fractures due to osteoporosis, which MR sequence is MOST useful in differentiating acute fractures from chronic fractures?
   A. T1-weighted fast spin echo
   B. T2-weighted fast spin echo
   C. T2-STIR (short tau inversion recovery)
   D. Diffusion-weighted

**Rationale:**
A: Although bone marrow edema from an acute compression fracture may be seen as reduced T1-weighted signal, the STIR sequence is more sensitive.
B: Edema from acute compression fractures is typically not seen on T2 weighted fast spin echo MR sequences. The marrow fat is bright on this sequence and obscures the edema due to the fracture.
C: The STIR sequence is a T2-weighted sequence which uses an inversion pulse to suppress marrow fat signal. Therefore the edema in the marrow from the acute fracture is apparent.
D: Diffusion weighted images have been proposed as a method to differentiate benign and malignant compression fractures. However, the sequence is susceptible to artifact and not widely available on clinical systems. STIR is more sensitive for fractures.

231. Which part of the brain demonstrates atrophy on imaging in Huntington’s chorea?
   A. Caudate nucleus
   B. Substantia nigra
   C. Globus pallidus
   D. Anterior temporal lobe

**Rationale:**
A: Prominent atrophy of the caudate nuclei is the most prominent imaging finding in Huntington disease. This is an autosomal dominant inherited neurodegenerative disease characterized by movement disorder and dementia.
B: Degeneration of the substantia nigra is associated with Parkinson Disease.
C: Iron deposition in the globus pallidus is associated with Hallervorden-Spatz disease. The globus pallidus is also susceptible to injury by carbon monoxide and other toxins.
D: Prominent atrophy of the anterior temporal lobes is seen in Alzheimer disease.
232. Tuberculosis of the spine MOST commonly involves which structure?

A. Spinal cord  
B. Intervertebral disc  
C. Vertebral body  
D. Meninges

**Rationale:**
A: Abscess of the spinal cord is rare.
B: The intervertebral disc is frequently involved by pyogenic bacterial infection, but mycobacterial infections usually spare the intervertebral disc.
C: Mycobacterial infections most commonly present as osteomyelitis of several adjacent vertebral bodies, with sparing of the intervertebral disc.
D: Tuberculous meningitis may occur in acutely ill patients. However, spondylitis (Pott's disease) is more common.

233. Which of the following statements regarding dose reduction techniques in pediatric neuroradiology is CORRECT?

A. Increased slice thickness produces exponential reduction in patient dose.  
B. Bismuth eye shields result in nondiagnostic scans due to artifacts.  
C. Increased kVp results in a net reduction in patient dose.  
D. Reduction in mAs is directly proportional to reduction in patient dose.

**Rationale:**
A: Slice thickness increases have a small effect on dose reduction that diminishes as the change increases.
B: Bismuth eye shields have been found to not produce significant artifacts by most investigators.
C: Increased kVp results in increased patient dose approximately by the square of the kVp.
D: Reduction in mAs reduces patient dose in direct relation to the reduction if all other parameters are maintained the same.

234. Polymicrogyria is MOST closely associated with which of the following infectious agents?

A. Herpes simplex type 2  
B. Toxoplasmosis  
C. Cytomegalovirus  
D. Rubella

**Rationale:**
A: Incorrect.
B: Incorrect.
C: Of the TORCH infections cytomegalovirus has the strongest association with the development of polymicrogyria. Occasionally toxoplasmosis or rubella infections may result in polymicrogyria. Herpes simplex type 2 is not a TORCH infection, that is herpes simplex type 1.
D: Incorrect.