Non-traumatic neurologic emergencies
Radiology

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Stroke

• Ischemic stroke
  – Thromboembolic
  – Vasculitis
  – Dissection
  – Post anoxic ischemia
Ischemic stroke

- Earliest signs are demonstrated on CT after 6-12 hours
- Faint loss of discrimination between grey and white matter
- Loss of well defined sulci
- High density may be seen in occluded arteries

Loss of discrimination and sulci
High density vessels

Ischemic stroke

• Perfusion CT shows areas with no flow or reduced flow
Occlusion of MCA after coil treatment

Ischemic stroke

- After 6-12 hours low density changes are seen
- Mass effect due to edema peaks between day 3-5
- Mass effect is gone in 2-4 weeks
Low density

Edema
Ischemic stroke

- Blood-brain barrier breaks after 3 days
- Enhancement may be seen for a few weeks
- Enhancement is gyriform in cortical infarcts
- Enhancement is ring-like in central parts of the brain
Enhancement

Ischemic stroke

• After weeks to months a loss of substance develops
• The defect is filled with CSF
• A secondary enlargement of the ventricles may be seen
Loss of substance

Ischemic stroke

- Earliest signs of ischemia on MR can be seen within a few minutes
- On DWI high signal is seen after a few minutes. The signal decreases during the next week
- ADC is low at first and increases over weeks
Nonischemic causes for decreased ADC

- Abscess
- Lymphoma and other tumors
- Multiple sclerosis
- Metabolic diseases (Canavans)
- Seizures
- Severe hypoglycemia
- Trauma
Ischemic stroke

- On PWI a reduced flow can be seen
- A hypoperfused area surrounding the DWI lesion may be seen – the penumbra
- The penumbra is the potentially salvageable tissue

Perfusion diffusion mismatch
Ischemic stroke

• On T2WI a high signal is seen after 6-8 hours.
• The signal increases over weeks until water values are reached when the tissue resorption is complete
• On T1WI low signal develops after 6-8 hours. The signal decreases until water values are reached

High signal on T2WI og DWI
Ischemic stroke

- On MRA a large vessel occlusion can be seen
Ischemic stroke

Vasculitis:
• CT may show poorly demarcated low density areas
• MR shows high signal changes on T2WI and FLAIR often in more than one area
• MRA is most often normal
High signal on T2WI and DWI

High signal on T2 and FLAIR
Narrowing of vessels

Takayasu

Before treatment

After treatment
Ischemic stroke

Dissection:
- Can cause stenosis or pseudoaneurisms
- Can give ischemic changes or hemorrhages
- On MRI thrombus can be seen in the vessel wall
- Normal flow void is not seen in the vessel or part of the vessel
Ischemic stroke

Post anoxic changes
- Affects globus pallidus
- Can affect other areas
Post anoxic changes

Drowning

CO

Post anoxic changes

Global ischemia
Stroke

- Hemorrhagic stroke
  - Intraparenchymal hematoma
  - Hemorrhagic infarctions
  - Venous thrombosis
  - Subarachnoid hemorrhage

Hemorrhagic stroke

Intraparenchymal hemorrhage:
- High density on CT images increases during day 1-3
- A surrounding low density rim consist of serum
- During the following days an edema develops
- Resorption starts in the periphery of the clot
- After a month resorption is complete
- Often very little is seen after resorption, a loss of substance may be seen
Intraparenchymal hemorrhage

- Hyper acute: T2 hyperintense, T1 hypointense
- Acute: T2 hypointense, T1 iso-hypointense
- Early subacute: T2 hypointense, T1 hyperintense
- Late subacute: T2 and T1 hyperintense
- Chronic: T2 and T1 hypointense

Hemorrhagic stroke

Intraparenchymal hemorrhage:
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Intraparenchymal hemorrhage

2 hours

Intraparenchymal hemorrhage

13 days
Intraparenchymal hemorrhage

3 months

Intraparenchymal hemorrhage

Cavernoma    AVM
Hemorrhagic stroke

Hemorrhagic infarction:
- Reperfusion in infarct
- Occurs 6-12 hours after the initial stroke, but can be seen a week or more after ictus
- Hemorrhage is often patchy
Hemorrhagic infarction

3 weeks

Hemorrhagic stroke

Venous thrombosis:
• Flow void in veins are replaced by clots
• The signal in the clots depends on the age of the clot
• Normal veins are subject to individual variations
• Infarcts or hemorrhages are often bilateral and subcortical
Venous thrombosis

Acute 4 weeks later
Venous thrombosis
Hemorrhagic stroke

Intratumoral hemorrhage:

- Degradation of blood is often slower than in simple hematomas
- Blood will often obscure tumor as well as enhancement

Intratumoral hemorrhage

Meningeoma
Intratumoral hemorrhage

Metastasis

Intratumoral hemorrhage

Pituitary adenoma
Hemorrhagic stroke

Subarachnoid hemorrhage:
- CT shows blood in subarachnoid space, in the ventricles or a hematoma
- CTA or MRA can demonstrate the aneurysm in most cases
- The final diagnosis is made by conventional angio
- Most aneurysms can be treated with coils
Subarachnoid hemorrhage

CTA
Subarachnoid hemorrhage
Infections

- Subdural empyema
- Meningitis
- Cerebritis
- Abscess
- Ventriculitis
- Herpes simplex encephalitis

Subdural and epidural empyemas

- Extracerebral fluid collection
- Enhancement of membranes
- 10% develops venous thrombosis
- Can spread to brain parenchyma as cerebritis
Subdural empyema

Meningitis

- A clinical diagnosis not a radiological diagnosis
- Radiological examinations are performed only when complications are suspected
- Most patients have normal scans
- Some have meningeal enhancement
- Some will get complications – hydrocephalus or infectious involvement of the brain
TB meningitis

Cerebritis

- Early phase of abscess formation
- Low signal on T1WI and high signal on T2WI and FLAIR
- No enhancement
Cerebritis

Abscess

- Enhancing rim, often thin and regular
- Considerable edema
- High signal on DWI and low on ADC
Abscess

T1 +C  DWI  ADC

Tumor

T1 +C  DWI  ADC
Ventriculitis

- Enhancement of ependyma
- Enlargement of ventricles
- Zones of low density around ventricles on CT
- Zones of high intensity around the ventricles on T2WI and FLAIR
Herpes simplex encephalitis

- Located in the temporal lobes, insula, the orbitofrontal region and cingulate gyrus
- Low density on CT
- High signal on T2WI and FLAIR
- Enhancement may be seen
Herpes simplex encephalitis
Hydrocephalus

- Colloid cyst
- Aqueductal stenosis
- Tumor
- Hematoma or infarct
- Infection, hemorrhage, carcinomatosis

Colloid cyst

- Located anterior in the third ventricle
- Signal on MR varies with protein content of cyst
- Often high signal on T1WI
- High density on CT
Colloid cyst

- Dilatation of lateral and third ventricle with normal fourth ventricle
- Can be diagnosed on CSF flow imaging

Aquaductal stenosis

- Dilatation of lateral and third ventricle with normal fourth ventricle
- Can be diagnosed on CSF flow imaging
Aquaductal stenosis

Tumor

- Pineal gland
- Tectum
- Posterior fossa
Hematoma or infarct

- Compression of third ventricle, aqueduct and fourth ventricle
- Complication of posterior fossa infarcts

Infarct in posterior fossa
Infection, hemorrhage, carcinomatosis

- Due to disturbance of resorption of CSF in arachnoid villi
- Caused by infection, SAH, carcinomatosis

Infection and hemorrhage

Ventriculitis  SAH
Diseases of the spine

- Disc herniation
- Diskitis and osteomyelitis
- Epidural abscess
- Metastasis
- Infarcts
- AVM
Degenerative diseases

Disc herniation:
- Large herniations may affect the cauda equina
- A free fragment (sequestered) can migrate
Infections

Diskitis and osteomyelitis:
- High signal in disc and vertebrae on T2WI and low on T1WI
- Enhancement in vertebrae and surrounding soft tissue
Diskitis and osteomyelitis

Epidural abscess:
- Often located in the dorsal epidural space
- Low signal on T1WI and high on T2WI
- Enhancement of granulation tissue
- No enhancement in the center of an abscess

Infections
Epidural abscess

Tumors

Metastasis:
- Normal high signal in vertebrae on T1WI is replaced by low signal
- High signal on T2WI
- Tumor masses may compress the spinal cord
Vascular lesions

Infarct:
- High signal in spinal cord
- Differential diagnosis includes MS and transverse myelitis
Vascular lesions

AVM:
- Can give rise to SAH
- High signal in spinal cord on T2WI due to high pressure in veins
- Dilated vessels are often seen surrounding the spinal cord

Dural fistula