Pathology of Nervous System

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Nervous System

- Central nervous system
- Peripheral nervous system
- Autonomic nervous system

Pathology of the CNS

- Basic pathologic change of the brain
- Trauma
- Cerebrovascular diseases
- Infection
- Degenerative diseases
- Tumors of the Nervous system

Basic Pathologic Change of the Brain
BRAIN HERNIATION

- Subfalcine herniation
  - Compress ACA
- Transtentorial (uncal) herniation
  - Compress midbrain
  - Compress PCA
- Tonsillar herniation
  - Compress respiratory center
Hydrocephalus
Noncommunicating hydrocephalus
- Congenital malformation: adeductal obstruction
- Tumor
- Inflammation
- Hemorrhage

Communicating hydrocephalus
- Choroid plexus papilloma
- Subarachnoid hemorrhage
- Meningitis
- Metastasis to subarachnoid space
- Hydrocephalus ex vacuo

- Skull fracture
- Cerebral parenchymal injury
  - Cerebral concussion
  - Direct parenchymal injury
- Spinal cord injury
- Traumatic vascular injury
  - Epidural hematoma
  - Subdural hematoma
  - Subarachnoid hemorrhage
Epidural hematoma
- Associated with skull fracture
- Dural arteries: middle meningeal artery
- Increased intracranial pressure → impair drainage via venous sinus
- Cerebral ischemia and hypoxia
- Brain herniation

Subdural hematoma
- Bleeding into subdural space
- 1 week: lysis of clot
- 2 weeks: growth of fibroblasts
- 1 to 3 months: development of hyalinized connective tissue
- The risk of repeat bleeding – greatest in first few months
- Slow progressive neurologic deterioration
CEREBROVASCULAR DISEASES
CEREBROVASCULAR ACCIDENT (CVA)
• Ischemia and infarction
  – Global cerebral ischemia
  – Focal cerebral ischemia

• Intracranial hemorrhage
  – Intraparenchymal (intracerebral) hemorrhage
  – Rupture Berry aneurysm
  – Vascular malformation

Global cerebral ischemia
• Shock, cardiac arrest, hypotension
• Pathology
  – 12-24 hours : red neuron
  – 1-14 days : necrosis, inflammatory cells, gliosis
  – 2 weeks : repair (gliosis)
• Watershed (border zone) infarction
Focal cerebral ischemia

- Thrombosis
  - Atherosclerosis
    - Bifurcation of carotid artery
    - Origin of middle cerebral artery
    - End of basilar artery
  - Arteritis
  - Coagulation defect
  - Drugs
- Emboli
  - Cardiac mural thrombi: MI, VHD, AF

Pathology
- Non-hemorrhagic infarction
  - Thrombosis
- Hemorrhagic infarction
  - Embolism
  - Venous thrombosis
Intracranial hemorrhage

- Spontaneous intracerebral hemorrhage
  - Hypertension
    - Hyaline change of arteriolar wall
    - Charcot-Bouchard microaneurysm
  - Putamen (50%), thalamus, pons, cerebellum
  - Amyloid angiopathy
  - Vasculitis
  - Aneurysm and vascular malformation
- Pathology: hemorrhage, edema, gliosis, hemosiderin-laden macrophages
• Ruptured Berry (saccular, congenital) aneurysm
  – Fourth common cause of CVA
  – 40-50 years
  – Smoking, HT
  – AD polycystic kidney disease, NF type I, Marfan syndrome
• Vascular malformation
  – Arteriovenous malformation
  • Convulsion
  • Intracerebral and subarachnoid hemorrhage
  • 10-30 years

INFECTION
Route of Infection

- Hematologic spread (most common)
- Direct implantation
- Local extension
- Spread via peripheral nervous system

- Acute meningitis
  - Acute pyogenic (bacterial) meningitis
  - Acute aseptic (viral) meningitis
- Chronic bacterial meningitis
- Viral meningoencephalitis
- Fungal meningoencephalitis
- Brain abscess
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PMN Lymphocyte Protein (g/dl) Sugar (CSF:Blood)
Normal 0 0-5 < 0.4 >0.6
Bacterial Meningitis 100-10,000 <100 >1.0 <0.4
Viral Meningitis <100 10-1,000 0.4-1.0 >0.6
Tuberculous Meningitis <100 50-1,000 1-5 <0.3

Bacterial Meningitis

Viral Meningitis

Tuberculous Meningitis

Normal

CSF:Blood
Fungal meningoencephalitis
- Candida, Mucor, Aspergillus, Cryptococcus
- Chronic meningitis
  - Cryptococcus
- Vasculitis
  - Mucor, Aspergillus, Cryptococcus
  - Thrombosis
- Parenchymal invasion
  - Candida, Cryptococcus, Mucor
  - Associated with chronic meningitis
  - Granuloma
  - Microabscess

DEGENERATIVE DISEASES
• Disease of the cerebral cortex
  – Alzheimer disease
  – Pick disease

• Disease of the basal ganglia and brain stem
  – Parkinson disease
  – Huntington disease

• Disease of the motor neuron
  – Amyotrophic lateral sclerosis

Alzheimer disease
• Most common cause of dementia in the elderly
  – Sporadic type
    • Late onset AD
    • Early onset AD (before age 65)
  – Familial type (early onset)
• Trisomy 21: strong association with AD
  – By age of 40, most Down syndrome have AD

• Pathogenesis
  – Accumulation of Aβ amyloid protein: derived of amyloid precursor protein
  – ApoE gene (apolipoprotein gene E)
  – Tau protein: microtubule-associated protein
Parkinson disease

- Progressive parkinsonism
  - Damage nigrostriatal dopaminergic system
  - Tremor
  - Slowness of voluntary movement (bradykinesia)
  - Abnormal involuntatary movement (rigidity)
- No underlying disease
- Pallor of substantia nigra and locus ceruleus
- Lewy bodies
TUMORS

• Neuroepithelial tumors
  – Astrocytic tumors: Astrocytoma, Glioblastoma multiforme
  – Oligodendroglial tumors: Oligodendroglioma
  – Ependymal tumors: Ependymoma
  – Embryonal tumors: Medulloblastoma

• Tumors of the meninges
  – Menigioma

• Metastatic tumors

• Neurocutaneous syndrome
  – Neurofibromatosis I, II

• Clinical features
  – Local effects
  – Mass effects
  – Not metastasize to other organs
  – Infiltration of adjacent tissues
• Secondary tumor: metastasis
  – Most common intracranial malignancy
  – Lung, breast, melanoma, colon, kidney
  – Boundary between gray and white matter
  – Subarachnoid space: carcinomatous meningitis

Neurocutaneous Syndrome

• Neurofibromatosis type I
  – NF1 gene, 17: neurofibromin
  – Neurofibroma, glioma of optic nerve
  – Lisch nodule (hyperpigmented nodule of iris)
  – Café au lait spot

• Neurofibromatosis type II
  – NF2 gene, 22: merlin
  – Bilateral acoustic neuroma
  – Multiple meningioma, glioma of spinal cord
Pathology of the PNS

- Traumatic neuropathy
- Tumor of the PNS

TRAUMATIC NEUROPATHY
TUMORS OF THE PNS

- Phalen sign
- Tinel sign
• Schwannoma (neurilemmoma)
  – Schwann cell
  – Cranial nerve 8
    • Cerebellopontine angle
    • Acoustic neuroma
  – Antony A
  – Antony B
• Neurofibroma
  – Cutaneous neurofibroma
  – Solitary neurofibroma
  – Plexiform neurofibroma
  – Neurofibromatosis

Thank You for Your Attention