Introduction Neuroimaging of the Brain

John J. McCormick MD
Normal appearance depends on age

Figure 2: Plain Computed Tomography (CT) Brain Axial Image: Normal ventricles and cortical sulci. No evidence of oedema or abnormal lesion.
Trauma

- One million ER visits/yr
- 80,000/yr develop long term disability
- 50,000/yr die
- 46% from transportation; 26% falls; 17% assaults. Other causes, such as sports injuries, account for rest.
- 2/3 < 30yrs old
- Men 2X as likely to be injured
- Cost of TBI is $48.3 billion annually
- A patient in mid-twenties with severe head injury is estimated to have a lifetime cost of 4 million dollars including lost work hours, medical and daily care
Skull Fracture

- Linear or depressed
- Skull base, middle meningeal artery
- Differentiate from suture and venous channels
Sutures
Traumatic Subarachnoid Hemorrhage
Acute Subdural Hemorrhage
Subacute Subdural Hematoma
Chronic Subdural Hemorrhage
Epidural Hematoma
Diffuse Axonal Injury
Coup-Contracoup
Intraventricular Hemorrhage
Stroke
National Stroke Ass’n Stats

• Third leading cause of death in US
• Someone suffers stroke every 53 seconds and every 3.3 minutes someone dies of a stroke
• 28% of those who suffer from stroke are under 65
• 15-30% are permanently disabled and require institutional care
• Estimated direct and indirect annual cost of stroke un US is 43.4 billion dollars
Stroke Subtypes

- Two major types: hemorrhagic and ischemic
- Hemorrhagic strokes caused by blood vessel rupture and account for 16% of strokes
- Ischemic strokes include thrombotic, embolic, lacunar and hypoperfusion infarctions
Intracebral Hemorrhage

- Most common cause: hypertensive hemorrhage
- Other causes: AVM, coagulopathy, tumor, venous infarction, drug abuse, amyloid angiopathy
Subarachnoid Hemorrhage
AVM
Ischemic Stroke

Thrombus lodges in the cerebral artery causing a stroke.

Thrombus in the carotid artery breaks off and travels to the cerebral artery in the brain.

Diseased carotid artery.

Normal carotid artery.

Blood clot stops the flow of blood to an area of the brain.

© Heart and Stroke Foundation of Canada
Intracranial Tumors

- Benign
- Malignant
  - Primary
  - Metastatic

• Focal neurological deficit
• Seizure
• Headache
Metastatic

**Figure 1:** Gadolinium-enhanced MRI can demonstrate multiple brain metastases from the glands surrounding each brain.
Glioblastoma Multiforme
Meningioma
Meningitis

- Three Subtypes
  - Pyogenic
  - Lymphocytic
  - Chronic (fungal, parasitic)
Pyogenic Meningitis

<table>
<thead>
<tr>
<th>Age distribution</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4 Years</td>
<td>55</td>
<td>83.3</td>
<td></td>
</tr>
<tr>
<td>5 – 8 Years</td>
<td>6</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>9 – 12 Years</td>
<td>1</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>13 – 16 Years</td>
<td>4</td>
<td>6.1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender distribution</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>26</td>
<td>39.4</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>40</td>
<td>60.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organism isolated</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemophilus influenza type b</td>
<td>33</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Streptococcus pyogenus</td>
<td>28</td>
<td>42.4</td>
<td></td>
</tr>
<tr>
<td>Nesseria meningitides</td>
<td>2</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

![Brain MRI image showing pyogenic meningitis](image)
Complications of Meningitis

- Hydrocephalus
- Ventriculitis/Ependymitis
- Subdural effusion
- Subdural empyema
- Cerebritis/Abscess
- Vasospasm/arterial infarcts
- Venous thrombosis/ venous infarcts
Hydrocephalus
Superior Sagital Sinus Thrombosis
Epidural Abscess
Degenerative Diseases

- Alzheimer’s Disease
- Parkinson’s Disease
- Huntington’s Disease
- Pick’s Disease
Alzheimer’s Disease

• Progressive and neurodegenerative
• >65% of patients with known dementia
• One in ten over 65yrs and 50% over 85yrs
• 4 million in US
• Female to male prevalence of 70%
• $100 billion per year
• Current Rx: acetylcholin esterase inhibitors, N-methyl-D-aspartate receptor antagonist
• Death from infection, malnutrition or total body system failure
Pathophysiology

- Aberrant processing of amyloid precursor protein (APP)
- Begins focally, primarily in hippocampal regions, succeeded by the parietal lobes and finally the occipital lobes
- Neuronal loss is severe and results in diffuse atrophy
Coronal MRI: Hippocampal Atrophy in AD

Parkinson’s Disease

- Idiopathic, chronic, progressive
- Characterized by: bradykinesia, resting tremor and increased tonicity of voluntary musculature and loss of postural reflexes
- 1 million people in US
- 50,000 new cases per yr
- 15% below 50yrs; 1% of people over 60yrs
- $25 billion/yr
- Current Rx: anticholinergic and dopaminergic medications

- If untreated, progresses to frank deterioration of all brain functions and total disability
Huntington’s Disease

• Progressive neurodegenerative disorder characterized by choreoathetoid movements, behavioral disturbances and progressive dementia
• Genetic with autosomal dominant inheritance and complete penetrance
• Dx between 30-60
• No cure
• Rx: dopamine antagonists
• 100% fatal
• Death from: infection (pneumonia), falls, suicide
Pick’s Disease

• Neurodegenerative disorder
• Behavioral and language disturbances out of proportion to memory deficits.
• 5% of all cases of senile dementia
• Affected between ages of 40 and 65
• No gender predilection
• No treatment
• Progresses relatively rapidly with death secondary to infection or body system failure
Pick’s Disease