Motor Dysfunction III: Concussion, Acquired Brain Injury, Seizures & Epilepsy

Concussion

• A mild injury to the brain following trauma
  – not life-threatening
• A concussion is caused when the brain receives trauma from an impact or a sudden momentum or movement change
  – may or may not lose consciousness
• The blood vessels in the brain may stretch and cranial nerves may be damaged
  – No bleeding, closed head

Concussion: Symptoms

• Headache
• Confusion
• Nausea & vomiting
• Blurred vision
• Loss of short-term memory
  – peri-event memory poor
• Perseverating
  – repeating the same thing
**Concussion: Grading system**

- **Three point scale**
  - based on the duration of unconsciousness and period of post-traumatic amnesia
- **Grade 1 (90% of concussions)**
  - No loss of consciousness
  - Transient confusion
  - Symptoms resolve in 15 minutes or less
  - Most difficult form of concussion to diagnose

**Concussion grading continued**

- **Grade 2**
  - No loss of consciousness
  - Transient confusion
  - Symptoms take longer than 15 minutes to resolve
  - Sometimes retrograde amnesia
- **Grade 3**
  - Loss of consciousness for any period

**Concussion: Treatment & Outlook**

- **Treatment**
  - Bump on the head: ice
  - Bed rest, fluids, mild pain reliever
  - Follow-up with physician
- **Outlook, short term problems: Post-concussive syndrome**
  - persistent headache lasting weeks to months; nausea; dizziness
  - Sports Injury Problem: wound healing takes at least 10 days, sports events take place every 7 days or less, which leads to…
Concussion: Long term problems
• Concussions are *cumulative*—i.e., it is easier to get another concussion
  – Repeated concussions can lead to long-term memory loss, psychiatric disorders, and other neurologic problems
    • Problems can persist 30 years
  – Youth more at risk
  – Reported youth concussion, 2007-8, USA
    • Football - 70,000 (estimates up to 200,000)
    • Girls soccer - 24,000
    • Boys soccer - 17,000
    • Girls basketball - 7,000

Second Impact Syndrome
• Caused by a second head injury before the symptoms of the first one have resolved
• Loss of autoregulation of the brain’s blood supply
  – leads to brain swelling, pressure on brain
• Time from impact to brainstem failure: two to five **minutes**
  – leads to death or severe disability

Acquired Brain Injury (ABI)
• Any type of brain injury that happens after birth
• Causes: accident or trauma, stroke, a brain infection, alcohol or other drug abuse
  – NOT damage related to genetic, developmental, or progressive disorders
• Largest cause = stroke (later topic)
• Next largest = traumatic brain injury, TBI
  – falls, mva, assault, sports injury
Some common difficulties after ABI

- Arousal (alertness)
  - worse early on, improves with recovery
- Communication (speech, language)
- Movement, mobility
- Fatigue
- Senses (over sensitivity, changes)
- Emotional/behavioural
  - agitation, depression, impulsivity
- Cognitive (attention, planning, memory)
- Seizures

Seizure

- Chronic condition = **epilepsy**
- Estimated 3% will be diagnosed
  - highest incidence, young children & elderly
- Includes positive and negative signs
  - Positive: perception of flashing lights, arm jerking
  - Negative: transient loss of consciousness, paralysis, blindness
- **Symptoms dependent on location and extent of brain tissue affected**

International Classification of Seizures

Seizures

I. Partial (focal) seizures
   - Simple partial seizures (with motor, sensory, autonomic, or psychological symptoms)
   - Complex partial seizures (alteration of consciousness)
   - Complex partial seizures evolving to secondarily generalized seizures
   - symptoms preceded by an aura (ahead)
II. Generalized seizures (convulsive or nonconvulsive)
   - Absence
   - Myoclonic
   - Clonic (rigid extension of limbs)
   - Tonic (jerking of limbs)
   - Tonic-clonic
   - Atonic
III. Unclassified

Source: Commission on Classification and Terminology of the International League Against Epilepsy (1981); Commission on Classification and Terminology of the International League Against Epilepsy (1985).
### Evolved terminology

<table>
<thead>
<tr>
<th>CURRENT</th>
<th>OLDER</th>
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<tbody>
<tr>
<td>Seizure</td>
<td>Fit</td>
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<td>Tonic-clonic seizure</td>
<td>Grand mal seizure</td>
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<tr>
<td>Absence seizure</td>
<td>Petit mal seizure</td>
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<tr>
<td>Partial seizure</td>
<td>Focal seizure</td>
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### Absence seizures
- brief disruption of consciousness, lasting from a few seconds to about half a minute
  - often occur in young children, commonly mistaken for daydreaming.
  - usually a loss of awareness for a few seconds.
  - can happen many times a day.

### Myoclonic seizures
- Involves a sudden contraction of muscles and can appear as a jerk of one or both arms or sometimes the head
  - one of the most common types of seizures, typically affecting children and young adults.
- May cause just a single jerk or several jerking movements.
  - very brief
  - often happen while falling asleep or within a short time of waking up.
Tonic-Clonic seizure
• sudden stiffness of the body, followed by muscle contractions or jerking motions.

Atonic seizures
• cause a sudden loss of muscle tone
  – may result in the dropping of the head or a limb, or lead to a fall to the ground. There also may be a brief loss of consciousness.

Simple partial seizure
• an electrical disturbance starts in one hemisphere of the brain, person stays conscious
  can spread to involve both sides of the brain.
Complex partial seizure

- Similar to simple partial seizure, but altered state of consciousness at onset
- Person may experience a change in awareness and may seem confused.

Warnings sign: Aura

- A warning that a seizure may begin, often described as a “funny feeling.”
  - can include a feeling of pins and needles or a strange taste or smell
- Odd feelings that can precede a seizure are also very similar to what happens during a simple partial seizure
  - So an aura may actually be a small seizure that may develop into a larger seizure or disappear

Triggers: Single episode

- Missing a dose of medication
- Tiredness
- Missing meals
- Taking illicit drugs
- Increased stress level
- Flashing lights
- Drinking alcohol
- Overheating or overexertion (hyperthermia, high fever)
Causes: Chronic episodes (epilepsy)

- Genetic
- Discrete cortical injury
  - encephalitis
  - head trauma, birth trauma
- Factors leading to the development of epilepsy are still a mystery, however
  - one hypothesis: an insult to the brain sets off a chain of physiological and anatomical changes that lead to chronic seizures

Underlying mechanism

- Change in excitability of single or groups of neurons
- Hyperexcitability
  - neuron stimulation followed by an electrical response (the afterdischarge) that becomes more extensive and prolonged with repeated stimuli until a generalized seizure occurs.
  - This process is called kindling and can be induced by both electrical or chemical stimuli.

Quantifying brain waves: Electroencephalography (EEG)

- Technique for studying seizure
  - uses electrodes housed in a cap pushed against the surface of the scalp
  - able to measure small changes in extracellular current flow from the summated activity of many neurons
  - good temporal resolution, poor spatial resolution (opposite to fMRI, PET)

Source: cogneuro-ntl-rihm.org/CNL_BAP.htm
Healthy EEG activity

- Represents the collective behaviour of cortical neurons
- Slow waves over occipital areas are characteristic of a relaxed, wakeful state

Seizure-related EEG activity

- See differences in brain wave activity with seizure
  - In response to neuronal synchronization & spread

Absence seizure in a 12 year old
Note abrupt onset, abrupt end and synchronous wave activity

Treatments

- Pharmacological: Anti-Epileptic Drugs
  - Phenytoin (Dilantin): for tonic-clonic & partial seizures
    - Primary site of action appears to be the motor cortex where spread of seizure activity is inhibited
    - Phenytoin tends to stabilize the threshold against hyperexcitability caused by excessive stimulation
  - Phenobarbital
    - Produces its anticonvulsant effect by depressing the motor cortex and raising the seizure threshold
Treatments

• Surgical
  – *last resort, obvious side effects from removal of brain tissue*
    • HM
    • Film #2, hemispherectomy

• And, if you live in Canada…