Current Thinking About Brain Health and Disorders

Paul Young, MD
Brain Health and Disorders: Current Thinking

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Current Thinking

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Nervous System

- PNS - Peripheral Nervous System
  - cranial nerves
  - spinal nerves
- CNS - Central Nervous System
  - brain
  - spinal cord
The Amazing Neuron

Total number of neurons ~100 billion
- More than 99% are interneurons
- Each neuron makes contact with ~10,000 other neurons

Synapse
### Essential CNS Principles

- Nerve cells (neurons) are extremely sensitive to loss of oxygen or glucose...
- Nerve cells never reproduce or duplicate...
- Axons (nerve fibers) in the CNS do not regenerate...

### Cerebral Cortex

- Separates human brain from all others
- Site of intellect and emotions

### Human Cerebral Cortex

[Image of human cerebral cortex]
Nerve cells (neurons) are extremely sensitive to loss of oxygen or glucose…

Axons (nerve fibers) in the CNS do not regenerate…

The Neuron Family

Glial cells:
Astro
Oligo
Micro

Central Nervous System (CNS) Divisions:
- Cerebrum: cortex
  - white matter
  - basal ganglia
  - thalamus/hypothalamus
- Cerebellum
- Brainstem: midbrain
  - pons
  - medulla
- Spinal cord
Cerebrum

Lobes:
- Frontal
- Parietal
- Occipital
- Temporal
- Limbic

Frontal Lobe

Motor function
- primary, secondary, supplementary
- eye movements, bladder
- motor speech / writing

Intelligence
- calculations
- rationalization
- intuition, judgement
- planning, foresight
- motivation, problem solving

Behavior / Emotions

Olfactory Function
Parietal Lobe
- Sensory Function
  primary, association
  processing of somatic and visual information (art and music)
  visual orientation, recognition of self and surrounding
  taste

Occipital Lobe
- Visual Function
  primary, association
  color, spatial orientation

Temporal Lobe
- Language function
  understanding and formulation
- Hearing (storage of auditory information-dominant)
- Storage of visual information- nondominant recognition of faces
- Long term memory
**Limbic Lobe**

- Formation of new memory
- Learning
- Behavior and emotions

**Limbic Circuit**

**Alzheimer Disease:**

Dementia

memory, cognition, orientation, and behavior
Attention Deficit
ADHD
Dyslexia

Obsessive-Compulsive
Schizophrenia
Depression

Left Hemisphere
n Language
n Intellectual process
  analytical thinking
  rationalization calculation
  verbalization

Right Hemisphere
n Emotional, non-verbal thinking
n Artistic skills
  drawing, composing music
n Spatial perception
Corpus Callosum
- Connection between Right and Left

Thalamus
- Control Center in Lower Animals
- Sensory / Motor Relay Center

Hypothalamus
- Regulates body temperature
- Water balance
- Sleep/wake cycles
- Feeding activity
- Milk ejection/uterine contraction
- Emotions
- Endocrine Function (pituitary gland)
Basal Ganglia

- Set the Tone for Posture
- Control Stereotyped Movements

Parkinson’s Disease

- Mask-like facial expression
- Pill rolling tremor
- Rigidity of trunk

- Slow, shuffling gait movements

Huntington’s Chorea

- Twitching movements of legs
- Diminished movements in frontal area of head
- Resting movements in dorsal area of head

- Deterioration movements in neck and face

- Severe tremor at base of head
Section Y

NATIONAL SOCIAL SECURITY DISABILITY LAW CONFERENCE

Cerebellum

- Motor Coordination Center

CSF

- CerbroSpinal Fluid

Hydrocephalus

- Block in CSF circulation with build up of fluid
Cerebellum
- Motor Coordination Center

Cerebrospinal Fluid (CSF)

Hydrocephalus
- Block in CSF circulation with buildup of fluid

Skull
- Protection of brain from touch, pressure, vibration, temperature change, ultraviolet light, etc.

Fontanelles
- Soft spots

Skull Fracture
- Linear
- Depressed

Strain patterns
- Lines of least resistance
Linear (bursting) skull fracture

Massive stellate fracture

Depressed skull fracture
Basilar skull fractures

Brain Coverings
- Meninges: Dura, Arachnoid, Pia
  - Subarachnoid space with cerebrospinal fluid (CSF)
  - Entire CNS suspended in fluid environment
  - Meningitis
    - Infection of CSF with inflammation of meninges (bacterial, viral, fungal)

Brain Injury
- Focal
  - Cranial nerve contusion/laceration
  - Major vessel laceration
  - Epidural hematoma
  - Subdural hematoma
  - Subarachnoid hemorrhage
  - Intraparenchymal hemorrhage
- Diffuse
  - Concussion
  - Diffuse axonal injury
- Secondary
Intracranial Volume = Space Inside Skull

- Skull volume = Brain + Blood + CSF + ?
- No room for anything else!

Focal vs Diffuse - Brain Injuries

Concussion: Biomechanics

- Forces applied to brain result in:
  - Deformation
    - Coup Contusions
  - Linear Acceleration (translational)
  - Countercoup contusions
  - Rotational Acceleration (angular)
  - Diffuse lesions
**Physiologic vs. Structural Brain Injury**

**Disruption of Axons**

**Concussion: Symptoms**
- Change in or Loss of Consciousness
- Physical Problems
- Mental status Changes
  - Cognitive
  - Emotional/Behavioral
- Amnesia
  - Anterograde
  - Retrograde
Change in Consciousness

- Dazed
- Stunned
- Drowsy
- Sleepy
- Irritable
- Change in sleep patterns
  - Difficulty falling or staying asleep

Physical Complaints

- Headache/Pressure sensation
- Fatigue
- Nausea and/or Vomiting
- Dizziness/Vertigo/Tinnitus/Hearing Loss
- Blurred Vision/Double Vision
- Sensitivity to light and noise
- Loss of taste and smell
- Diminished libido

Cognitive Complaints

- Confusion
- Slowed information processing
  - Mental sluggishness
  - Mental fogginess
- Faulty Judgment
- Impaired concentration and attention
- Difficulty remembering
- Slowed reaction time
- Forgetfulness
Emotional/Behavioral

- Irritability
- Emotional Outbursts
- Unemotional
- Nervous
- Anxious
- Depressed or sad
- Aggressive or inappropriate behavior

Best Approach?
Prevention !!!!!!!

Traumatic Brain Injury

Acute Subdural
Cognitive Complaints

- Confusion
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Best Approach?

Prevention

Traumatic Brain Injury

Acute Subdural

Diffuse Axonal Injury

Contusion

Evaluation/Prognosis

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<tr>
<th>Category</th>
<th>Response</th>
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<td>Follows commands</td>
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Acute Epidural Hematoma - Uncal Herniation

Acute Subdural Hematoma
**Brain Contusion**

39 year-old comatose following MVA

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**Brain Herniation= Irreversibility**

- Downward pressure from hemispheres and/or basal ganglia
- Displacement of diencephalon and midbrain rostrocaudally through tentorial notch

---

**Brain Herniation= Terminal Event**
Headache

Mechanisms:

- Muscle tension (inflammation)
- Vascular dilatation (migraine)
- Sinus inflammation (also meningitis)
- Brain tumor
- Limbic overflow

Headache Classification

- Migraine
  - Common, Classic
- Cluster
- Tension
- Psychogenic
- Intracranial
- Extracranial
- Cranial Nerve
- Referred
- Toxic
- Metabolic

Intracranial Causes

- Meningeal
  - Meningitis, Encephalitis, SAH, LP
- Space occupying
  - Tumor, hematoma, abscess
- Elevated Arterial Pressure
  - Cough, exertional, orgasmic, altitude, pheo, drug
- Elevated Venous Pressure
- Cerebral Edema
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42 year-old with sudden headache and right field cut

Malignant Melanoma

30 year-old with progressive lethargy and right hemiparesis

Hydatid Cyst

Toxic

- Fever
- Drugs and Alcohol
- Drug Withdrawal
Referred
- Eyes
- ENT
- Dental
- Cervical

Brain Neoplasms

Types:
- Metastatic
- Primary
  - Glioblastoma multiforme
  - Meningioma

11 year-old with headaches
Current Thinking About Brain Health and Disorders

What is a stroke?

A stroke occurs when the blood supply to a part of the brain tissue is cut off, and as a result, the nerve cells in that part of the brain cannot function.

Strokes are the third leading cause of death in the United States, taking 180,000 lives each year.

Strokes are the leading cause of disability in the United States.
What is a stroke?

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Which individuals are more likely to have a stroke?

Those with:
- elevated blood pressure
- heart disease (of any kind)
- diabetes
- atherosclerosis
- blood clotting defects
- obesity (couch potato lifestyle)
- cigarette consumption
- advanced age (elderly)

Stroke Syndromes

- Hemorrhagic
- Ischemic
  - Embolic
  - Hemodynamic

Warning signs of a brain bleed

Hemorrhage
- sudden unexplained headache
- stiffness in back of neck
- loss of consciousness
Brain Hemorrhage

Intracerebral Hemorrhage
- Hypertensive Cerebral Saccular (berry) Aneurysm
Cerebral Saccular (berry) Aneurysm

Increasing Obtundation

Brain Hemorrhage

Intracerebral Hemorrhage - hypertensive

Cerebral Saccular (berry) Aneurysm

Subarachnoid Hemorrhage

Arteriovenous Malformations (AVM)

Ischemic Stroke

Warning Signs of Ischemic Stroke
- loss of vision (one eye or both)
- weakness of arm(s) or leg(s)
- drooping of the face
- numbness of arm(s), leg(s), or face
- difficulty speaking or swallowing
- loss of hearing
- incoordination
- confusion
Subarachnoid Hemorrhage

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66 year-old with progressive coma following TIAs

MCA/ACA Infarction

Transient Ischemic Attack (TIA)

Stroke’s warning signs may often last for only a few minutes.

Because of this, many people ignore them.
66 year-old with progressive coma following TIAs

MCA/ACA Infarction

Transient Ischemic Attack (TIA)

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Carotid Artery Stenosis

A frequent site of atherosclerosis

Carotid Endarterectomy
Brain Embolus

Why do some people recover from strokes and others do not?

Depending on:
- which brain cells have been damaged
- how wide spread the damage is
- how effectively the body can repair its system of supplying blood to the brain
- how rapidly other areas of the brain tissue can take over the work of the damaged brain cells

THE END