Neurological Deficits per Location of a Stroke

Imad S Khan
Research Fellow
J.B Marshall Lab of Endovascular Neurotherapeutics
Vanderbilt University Medical Center Stroke Symposium 2013
Disclosure

• I have no relevant financial or non-financial relationships in the products and services described, evaluated or compared in this presentation.
Outline

• What is a stroke?
• Why talk about it?
• Basic Anatomy of the brain
• Functions of different regions of the brain
• Blood supply of the brain
• Introduction to stroke symptoms
• Summary
What is Stroke

• 400 BC. The Greek philosopher Hippocrates described the stroke phenomenon as sudden Paralysis.

• Apoplexy-struck down
A Brain Attack

- When a clot breeches the blood supply to the brain or a vessel bursts open causing damage.
- Symptoms depend on the type of stroke and the area of the brain affected.
Why talk about it?

• WHO-15 million people Worldwide claiming 5 million deaths & 5 million left with permanent damage

• One American dies every 4 minutes from stroke

• Approximately $73.7 billion in 2010 for stroke-related medical costs and lost productivity

• 4th leading cause of death in the United States.
Stroke Belt!
Stroke Risk Factors

- Age
- Sex
- Race
- Prior stroke
- Family history

- High Blood Pressure
- Heart Disease
- Cigarette Smoking
- TIAs
- Diabetes
- Elevated Blood Cholesterol/Lipids
- Asymptomatic Carotid Bruits
What you know about stroke could save a life.
Early Action Is the Key

• We need to identify the symptoms of a stroke and the high risk population

• Symptoms depend on the type of stroke and the location of the brain affected.
Anatomy of the Brain
The lobes of the brain

- Frontal Lobe
- Parietal Lobe
- Temporal Lobe
- Occipital Lobe

Functions of the brain
Frontal Lobe

- Attention and concentration
- Self-monitoring
- Organization
- Speaking (expressive language)
- Motor planning and initiation
- Awareness of abilities and limitations
- Personality
- Mental flexibility
- Inhibition of behavior
- Emotions
- Problem solving
- Planning and anticipation
- Judgment
Motor Homunculus
- Memory
- Understanding language (receptive language)
- Sequencing
- Hearing
- Organization
Parietal Lobe

- Sensation
  - Touch
  - Pressure
  - Pain
  - Temperature
  - Texture

- Spatial/Positional perception
- Differentiation (identification) of size, shapes, and colors
- Visual perception
Sensory Homunculus
Orientation of the Homunculi
Occipital Lobe

- Vision
- Visual processes
  - Reading
Brainstem

- Breathing
- Arousal and consciousness
- Attention and concentration
- Heart rate
- Sleep and wake cycles

Cerebellum

- Balance
- Skilled motor activity
- Coordination
- Visual perception
Basal Ganglia and Thalamus

- “The Brakes”
- Modifies movement on a minute-to-minute basis
- Inhibits Movement
- Coordination
- Cortical relay
Limbic System

- Attention
- Sensory gateway
- Memory processing
- Rage
- Aggression
- Sexuality
- Appetite/Thirst
Functions of the brain

Frontal lobe
- behaviour
- intelligence
- memory
- movement

Parietal lobe
- intelligence
- language
- reading
- sensation

Occipital lobe
- vision

Temporal lobe
- behaviour
- hearing
- memory
- speech
- vision

Brain stem
- blood pressure
- breathing
- consciousness
- heartbeat
- swallowing

Cerebellum
- balance
- coordination

Pascalis Spyrou
I AM THE LEFT BRAIN

Reason
Logic
Accurate
Analytic

I AM THE RIGHT BRAIN!

Strategic
Control
Science

Passion
Vivid
Creative

123456789

Vanderbilt University Medical Center Stroke Symposium 2013
Left Brain*
Logical
Sequential
Rational
Analytical
Objective
Looks at parts

Right Brain
Random
Intuitive
Holistic
Synthesizing
Subjective
Looks at wholes

*Source: Funderstanding.com, Inc., New Jersey
Functions related to the side of the brain

analytical
logical
precise
repetitive
organized
details
scientific
detached
literal
sequential

creative
imaginative
general
intuitive
conceptual
big picture
heuristic
empathetic
figurative
irregular
Types of Stroke

- Ischemic Stroke (Blockage)
- Hemorrhagic Stroke (Bleeding)
PUSH
If That Doesn’t Work
PULL
If That Doesn’t Work
We Must Be Closed.

www.thefunnyblog.org
Territory of the cerebral vessels

- Anterior Cerebral Artery (light blue)
- Middle Cerebral Artery (pink)
- Posterior Cerebral Artery (light green)
Circle of Willis
Stroke Left Brain

Paralyzed Right Side

Speech-Language Deficits

Slow, Cautious Behavioral Style

Memory Deficits

Stroke Right Brain

Paralyzed Left Side

Spatial-Perceptual Deficits

Quick, Impulsive Behavioral Style

Memory Deficits
Middle Cerebral Artery (MCA) Occlusion

- Contralateral lower face weakness
- Contralateral hemiplegia
- Contralateral hemianesthesia
- Ataxia
- Speech impairments (usually the left brain)
- Perceptual deficits (usually the right brain)
- Visual deficits
Anterior Cerebral Artery (ACA) Occlusion

- Weakness of foot and leg
- Sensory loss of foot and leg
- Ataxia
- Incontinence
- Slowness and lack of spontaneity
Anterior Cerebral Artery (ACA) Occlusion

- Occlusion proximal to ACOM is well tolerated

- Distal Occlusion results in
  - Weakness and cortical sensory loss in contralateral lower limb
  - Incontinence

- Bilateral ACA
  - akinetic mutism
  - Deterioration in conscious level
Posterior Cerebral Artery (PCA) Occlusion

- Midbrain syndrome (Weber’s Syndrome)
  - Third nerve palsy
  - Contralateral hemiplegia

- Thalamic Syndromes
  - Chorea or hemiballismus
  - Hemisensory disturbances

- Visual field deficits (macular sparing)

- Visual hallucinations

- Memory problems
Brainstem Stroke

• Double vision

• Face weakness and sensation weakness

• Taste disturbances

• Hearing loss

• Difficulties in balancing and dizziness

• Difficulties in swallowing

• Blood pressure and respiration dysfunction
Basilar Artery Occlusion

- Complete Basilar Syndrome
  - Impairment of consciousness
  - Bilateral Sensory and Motor dysfunction
  - Cerebellar signs
  - Cranial nerve signs indicative of site

- “Top of Basilar” Occlusion
  - Lateral midbrain, thalamic, occipital and medial lobe infarction
  - Hemiballismus
  - Visual loss
  - Pupillary abnormalities
  - Gaze palsies
  - Impairment of consciousness
Occlusion of Paramedian Perforating Vessels

- “Locked-In” Syndrome
  - Quadriplegia
  - Inability to speak
  - Intact cognition
  - May retain proprioception and sensation
  - Lack coordination between breathing and voice

Basilar artery

Paramedian perforating vessels
Anterior Inferior Cerebellar Artery Syndrome (Lateral Pontine Syndrome)

- Cerebellum
  - Ipsilateral limb ataxia

- Brainstem
  - Ipsilateral Horner’s syndrome
  - Ipsilateral sensory loss
  - Ipsilateral facial weakness
  - Contralateral sensory loss (pain/temperature)
Posterior Inferior Cerebellar Artery Syndrome
(Lateral Medullary Syndrome/Wallenberg Syndrome)

Cerebellum
- Dysarthria
- Ipsilateral limb ataxia
- Vertigo
- Nystagmus

Brainstem
- Ipsilateral Horner’s syndrome
- Ipsilateral sensory loss
- Ipsilateral pharyngeal and laryngeal paralysis
- Contralateral sensory loss (pain/temperature)
### Classification of subtypes of cerebral infarction

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Clinical features</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Anterior Circulation Syndrome</td>
<td>Motor and sensory deficit, hemianopia and disturbance of higher mental function</td>
<td>Poor</td>
</tr>
<tr>
<td>Partial Anterior Circulation Syndrome</td>
<td>Any two of the above or isolated disturbance of cerebral function</td>
<td>Variable</td>
</tr>
<tr>
<td>Posterior Circulation Syndrome</td>
<td>Signs of brainstem dysfunction or isolated hemianopia</td>
<td>Variable</td>
</tr>
<tr>
<td>Lacunar Anterior Circulation Syndrome</td>
<td>Pure motor or sensory stroke Or pure sensorimotor stroke Or ataxic hemiparesis</td>
<td>Good</td>
</tr>
</tbody>
</table>
Summary

• Stroke is one of the most common diseases causing morbidity and mortality in the US

• Stroke signs and symptoms depend upon the site of the brain affected
  – Different lobes have different functions
  – Hemispheres have different functions and control the opposite side of the body
• So when you see signs of stroke act **FAST** and call **9-1-1** immediately!
Any Questions???