Stroke and Brain Injury

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Overview

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What is a Stroke?

• A stroke is the rapidly developing loss of brain function due to disturbances in the blood supply to the brain

• Aka “cerebrovascular accident or brain attack”

- The majority of strokes (87%) are ischemic, resulting from thrombosis or embolism.
- 10% of strokes are due to a hemorrhage or rupture of a vessel in the brain which leads to leaking of blood into the brain tissue and cerebrospinal fluid.
Hemorrhagic vs. Ischemic stroke

A hemorrhagic stroke occurs when a blood vessel bursts within the brain.

An ischemic stroke occurs when a blood clot blocks the blood flow in an artery within the brain.
What is a Brain Injury?

• Aka “Traumatic Brain Injury” (TBI)
• Results from a blow or jolt to the head from a penetrating head injury, or from being violently shaken.
• TBI causes permanent damage to the brain, resulting in total or partial functional disability or psychosocial impairment, or both.
Epidemiology for Stroke

- 3rd leading cause of death in America and number one cause of adult disability
- About 137,000 Americans die of stroke every year
- Every year 795,000 people in the US have a stroke. 610,000 are first time or new strokes. 185,000 people who survive a stroke will have another one.
- Someone in the US has a stroke every 40 seconds. Every 3-4 minutes someone dies of a stroke
- Males are 1.5 times more likely to have a stroke than females until the age of 74, when the incidence rate equalizes
- ~25% of stroke victims die as a result of the event itself or its complications, and roughly 50% will have moderate to severe health impairments and long-term disabilities
- The country’s highest death rates due to stroke are in the southeastern United States.
Percentage of People Who Were Ever Told They Had a Stroke, 2008

Age-adjusted to the 2000 U.S. standard population.
Epidemiology for Brain Injury

- ~1.4 million new cases of TBI occur each year in the US; 50,000 of these people die and 85,000 have long-term disability.

- TBI is a contributing factor to a third of all injury-related deaths in the US.

- The typical ages of onset for a TBI are between 0 and 4 years, between 15 and 19 years, and then later in life (75 years +).

- Males aged 0 to 4 years have the highest rates of TBI-related emergency department visits, hospitalizations, and deaths.

- Falls and motor vehicle accidents are the most common causes.

- Direct medical costs and indirect costs such as loss productivity of TBI totaled an estimated $60 billion in the US in 2003.
STROKE RISK FACTORS

ESTIMATED INCREASE IN RISK

ATRIAL FIBRILLATION  17 times
HYPERTENSION  2 TO 4
CARDIAC DISEASE  2 TO 4
NO EXERCISE  1.8 TO 3.5
DIABETES  1.5 TO 2.5
SMOKING  1.5 TO 2.5
HEAVY ALCOHOL USE  1 TO 3
Complications

Stroke

• Paralysis or problems controlling movement
• Sensory disturbances
• Problems using or understanding language
• Emotional disturbances

Brain Injury Impairments in one or more of the following:

- Cognition
- Language
- Memory
- Attention
- Reasoning
- Abstract thinking
- Judgment
- Problem solving
- Sensory

- Perceptual
- Motor abilities
- Psychosocial behavior
- Physical functions
- Information processing
- Speech
Treatment (Stroke)

- Medical treatments for stroke survivors includes the following:
  - Short-term use of anticoagulants and long-term use of platelet inhibiting agents (heparin, coumadin, and aspirin)
  - Vasodilators if vasospasm of the cerebral arteries is suspected (hydralazine, clonidine, or isordil)
  - Antihypertensive medications after hemorrhagic stroke requiring strict control of blood pressure
Treatment (Brain Injury)

- Some people with a brain injury may require more intensive postacute medical management.
- Seizures and spasticity may necessitate long-term anticonvulsant and antispasmodic medications.
- Some individuals receive medical therapy for the treatment of depression or anxiety after TBI which can cause dizziness, hypotension, and altered arousal states.
- Some drugs may be used to combat cognitive defects in people with TBI or stroke (tacrine, sinemet, ritalin, etc).
Treatment

- Physiological responses to medications
  - Vasodilators may increase the cool-down period required after exercise to prevent post-exercise hypotension
  - Medications that limit cardiac output by reducing heart rate may cause lower peak heart rates
  - Diuretics reduce fluid volume and alter electrolyte balance, causing dysrhythmias
How can I Prevent a Stroke?

• Eat a healthy diet
• Maintain a healthy weight
• Be active!!!
• Don’t’ smoke
• Limit alcohol use
Effects on the Ability of Exercise

- Overall functional capacity is typically low in individuals who have recently sustained a TBI or stroke.
- Functional implications for stroke and TBI survivors:
  - Breathe harder with exertion
  - Fatigue 2.5 times more rapidly
  - Less efficient in mobility skills and activities of daily living

**Thus, they are more likely to adopt a sedentary lifestyle with increased risk of negative secondary conditions.**
Effects of Exercise Training

Exercise alone can reduce mortality by 20% or more.

- General Benefits
  - 60% greater VO\textsubscript{2peak}
  - Improved oxygen consumption
  - Workload response
  - Blood pressure
  - Resting heart rate
  - Cholesterol levels
  - Increased walking speed
  - Decreases ambulation (walking) assistance
  - Functional mobility
Effects of Training

• Specific exercise programs may have limited benefits.
• The American Heart Association (AHA) recommends stretching, flexibility, balance, and coordination exercises 2-3 times per week.
• Muscle weakness frequently results from stroke, so the AHA recommends strength training with light resistance 2-3 days per week.
TBI and Exercise Training

- Although most individuals with TBI are young, their physical capacities and endurance may be severely limited by multisystem trauma.
- Exercise benefits specifically for TBIs include:
  - Improved VO_{peak}
  - Improved endurance
  - Muscle strength
- These benefits result in greater independence, more efficient locomotion, and greater employability
Exercise Testing

“Exercise is a normal human function that can be undertaken with a high level of safety by most people, including stroke survivors. However, exercise is not without risks, and the recommendations that stroke survivors participate in an exercise program is based on the premise that the benefits outweigh the risks. Therefore, the foremost priority in formulating the exercise prescription is to minimize the potential adverse effects of exercise via appropriate screening, program design, monitoring, and patient education.”
Exercise Testing

- Biggest challenge in exercise testing is each client’s abilities and severity of complications is different from person to person.
- Many stroke victims currently have or are at risk for cardiovascular disease, therefore their tests should be supervised by physician and monitored with a 12-lead ECG.
- The mode of exercise testing depends on the severity of physical impairments.
Modes of Exercise Testing

- Leg cycle ergometry
- Treadmill
- Combined arm-leg ergometry
- Steppers
- Computerized dynamometer: muscle strength
- Flexibility tests
- Neuromuscular tests: Berg Balance Scale, gait analysis, NIH Stroke Survivor Scale, Postural Sway

** Exercise equipment usually must be adapted to accommodate client’s motor impairments.
Special Considerations for Exercise Testing

- Large percentage of clients on hypertension medication (vasodilators)
- Seizure-prone clients on anticonvulsant medications
- Arthritis in common in clients = reduced ROM
- Reduced motor control of limbs
- Sensation may be impaired
Exercise Prescription

• The AHA recommends endurance training programs for individuals with brain lesions, citing documented physiological, psychological and functional benefits

• Experts suggest a three tier program
  ▫ First phase: goal of exercise is to return to function
  ▫ Second phase: goal is to decrease risk of additional strokes
  ▫ Third phase: goal is to improve aerobic fitness
# Exercise Programming

<table>
<thead>
<tr>
<th>Modes</th>
<th>Goals</th>
<th>Intensity/Frequency Duration</th>
<th>Time to goal</th>
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</thead>
<tbody>
<tr>
<td>Aerobic</td>
<td>-increase independence of ADLs</td>
<td>40-70% of VO$_{2peak}$</td>
<td>2-4 months</td>
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<tr>
<td></td>
<td>-Increase walking speed</td>
<td>3-5 days/week</td>
<td></td>
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<tr>
<td></td>
<td>-Decrease risk of CVD</td>
<td>20-60 min/session (or multiple 10 min sessions)</td>
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<tr>
<td>Strength</td>
<td>-increase independence of ADLs</td>
<td>3 sets of 8-12 reps</td>
<td>2-4 months</td>
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<tr>
<td></td>
<td></td>
<td>1-2 exercises</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2 days/week</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>-increase ROM of involved extremities</td>
<td>2 days/week (before or after aerobic or strength activities)</td>
<td>2-4 months</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>Improve levels of safety during ADLs</td>
<td>2 days/week</td>
<td>2-4 months</td>
</tr>
<tr>
<td>Coordination and balance activities</td>
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Exercise Environment

• Consider behavioral factors when selecting the most appropriate environment for exercise
  ▫ Impulsivity
  ▫ Aggression
  ▫ Lack of judgment
  ▫ Misunderstanding of directions
Final Considerations

• Depression and apathy are common following a stroke or TBI and might interfere with long-term adherence to an exercise program.
• Cognitive deficits may interfere with ability to follow directions in testing and training.
• Inflexibility and imbalance can hinder exercise and functional mobility.
• Seizures are common and pose safety concerns during exercise.
Summary

• Recurrent stroke and cardiovascular disease are the leading causes of mortality in stroke survivors
• The main goal of exercise with stroke and brain injury patients is to increase independence in activities of daily living and reduce risk for recurrent stroke
• Each client’s abilities and complications require highly individualized exercise testing and prescription


www.cdc.gov/stroke/about.htm