Stroke Rehabilitation Update
Advances in Neurosciences
May, 2014

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Disclosures:

• I do not have any relevant financial relationships to disclose

• Darn
Agenda

• Stroke rehabilitation and recovery
• Neural Recovery and “Plasticity”
• Botulinum toxin for arm spasticity
• Medications for stroke recovery-SSRIs?
• Emerging Rehab Therapies. Do they affect outcomes?
If YOU don’t have a stroke, chances are you already have or will have a close relative with one.

World Stroke Awareness Day

1 in 6 people worldwide will have a stroke in their lifetime.
USA new strokes/Year: 800,000

- Stroke prevalence in US: 6.5 million
- 25-74% with significant physical, cognitive, and emotional deficits
- $36.5 BILLION cost
- What’s the role of rehabilitation?
How does a brain recover from Stoke?

• Recovery of “stunned” brain cells/edema
• New blood vessels/removal of necrotic tissue
• Initial over-activation of brain regions, followed by typically normal activation.
• Changes in inhibition
• New dendrites/connections
What Influences the brain in its recovery?

• “Exercise the brain”
  • Motor
  • Sensory
  • Language
Brain Recovery after Stroke

• Brain Forms New “Engrams” or “Memory Trace”

• Neural pathways of coordinated learned movement or thoughts
  • “Long-term potentiation”
Brain Recovery: How We Learn

Motivation
Repetition and Accuracy:
• “Procedural memory” or movement skill
• “Declarative memory” of facts & events
fMRI

• “...activation can shift almost entirely to the nonstroke hemisphere, especially for larger strokes”
• “...the best outcomes are associated with the greatest return to the normal state of brain function”
  
A. Movements of the stroke-affected (right) hand

B. Movements of the unaffected (left) hand
Neurological recovery generally weeks to months

• Walking and self care recovery generally plateaus by 3-6 months
Figure 8-2
Life Table Analysis. Probability of walking ≥ 150 ft. w/ assistance.

Probability

Motor deficit
Motor, sensory deficit
Motor, sensory, visual deficit

WEEKS AFTER STROKE
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Figure 8-3
Life Table Analysis. Probability of reaching a Barthel score \( \geq 60 \).
Rehabilitation

• The maintenance and restoration of physical and psychological health necessary for independent living and physical independence
Rehabilitation Goals

Improve mobility
Self cares
Language/swallowing
Adaptive equipment
Rehabilitation

• Improve on the natural history of "stroke recovery"
• Earlier acquisition of skills
• Enhance actual recovery?
Why does Medicare pay for stroke inpatient rehab units?

• Strong evidence for reduced:
  • morbidity
  • mortality
  • need for institutionalization/ long term care
  • long term disability

  • Miller et al. AHA Scientific Statement. Comprehensive Overview of Nursing and Interdisciplinary Rehabilitation Care of the Stroke Patient. Stroke. 2010
Enhanced Neural Recovery: Constraint Induced Movement Therapy

• Also called “Forced Use” or “Repetitive Task Practice”
• Typically outpatient phase
• Intense repetitive use of affected arm, leg, language
Intense motor practice seems to improve motor function

- Patient motivation
- Expensive
- Home emphasis

Wolf et al. Effect of constraint induced movement therapy on upper extremities function 3-6 months after stroke. The EXCITE randomized clinical trial. JAMA 2006
Enhanced Neural Recovery: Robots for Rehab

• Automated or robot-assisted motor rehabilitation
• Repetition and accuracy
• 1000 repetitions or more in one 45 minute session
• Robot provides as little assistance as possible
• Neurons that FIRE TOGETHER, WIRE TOGETHER
Robot-assisted rehab
Robot assisted motor rehabilitation

• Research from several RCTs
  • Improved power of affected limb up to 3 year f/u
  • Improved ADLs compared with controls up to 6 months after intervention

Robot assisted arm training Cochrane review

• 19 trials
• Randomized, post stroke
• Compared with other rehab or placebo or no treatment

  • Electromechanical and robot-assisted arm training for improving generic activities of daily living, arm function, and arm muscle strength after stroke. Mehrholz et al. Cochrane Database Syst Rev. 2012
2012 Cochrane Review
electromechanical and robot-assisted arm training Outcomes

• ADLs Improved
• Arm function improved
• Arm strength no improvement
Enhanced Neural Recovery: Partial Body Weight Supported Treadmill Walking. Early reports Not Encouraging

• “Randomized trials initiated during inpatient rehabilitation...have shown clinically insignificant increases in speed and distance of walking, as compared with conventional training...More data are needed...to assess...patients who persistently walk poorly at three to six months after a stroke...”

Lower extremity robotic/treadmill
Recent reports Not encouraging

• Not much evidence to support use

• Similar outcome to standard PT
  • Duncan et al. Body-weight-supported treadmill rehabilitation after stroke. NEJM 2011
Enhanced Neural Recovery:

• External brain stimulation?
  • Transcranial magnetic stimulation
  • Direct current
• Peripheral electrical stimulation—some evidence
• Medications—nothing FDA approved
• Virtual reality
Will Rehab come in pill form?

Pharmacology: Nothing FDA approved for stroke rehab

Role of SSRI/SNRIs?
SSRIs help post-stroke depression and functional outcomes

• Meta-analysis of 10 randomized trials
• 703 non-depressed stroke patients
• Post-stoke depression developed in 12.5% patients receiving antidepressants compared with 29% controls

Depression scales, difficult to apply to acute or sub-acute stroke survivors

The Patient Health Questionnaire (PHQ-9)

<table>
<thead>
<tr>
<th>Over the past 2 weeks, how often have you been bothered by any of the following problems?</th>
<th>Not At all</th>
<th>Several Days</th>
<th>More Than Half the Days</th>
<th>Nearly Every Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Little interest or pleasure in doing things</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Feeling down, depressed or hopeless</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Trouble falling asleep, staying asleep, or sleeping too much</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Feeling tired or having little energy</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Poor appetite or overeating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Feeling bad about yourself - or that you’re a failure or have let yourself or your family down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Trouble concentrating on things, such as reading the newspaper or watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Moving or speaking so slowly that other people could have noticed. Or, the opposite - being so fidgety or restless that you have been moving around a lot more than usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Thoughts that you would be better off dead or of hurting yourself in some way</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. If you checked off any problems, how difficult have those problems made it for you to do your work, take care of things at home, or get along with other people?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Not difficult at all</td>
<td>□ Somewhat difficult</td>
<td>□ Very difficult</td>
<td>□ Extremely difficult</td>
<td></td>
</tr>
</tbody>
</table>
SSRIs for neurological recovery in addition to treatment of depression

• Improved Motor function

• Improved Executive function
52 trials meta-analysis

• “SSRIs appear to improve dependence, disability, neurological impairment, anxiety, and depression after stroke...”

“If you remember, I did mention possible side-effects.”
SSRI Caution

- Bleeding concern in acute hemorrhagic stroke (?)
- Nausea/diarrhea
- Hyponatremia
- Elderly more susceptible to side-effects
Stroke Rehab
Botulinum toxin Injection

• Botulinum toxin A injections for wrist and finger spasticity: Multicenter, double-blind, placebo controlled trial.

• Reduces spasticity
• Decreased disability
• Few side effects

  • Brashear. Intramuscular injection of botulinum toxin for the treatment of wrist and finger spasticity after a stroke. NEJM 2002,347:395-400
Recent meta-analysis of 16 botulinum studies

• “Moderate” improvement in upper-extremity activity and performance after stroke.

Virtual reality: “Wii-hab”?  

• Cochrane view: Some “Limited evidence” of improved arm and “self care” function  
• Insufficient evidence that it helps grip strength or walking speed
  
  • Laver et al. Virtual reality for stroke rehabilitation. Cochrane Database Syst Rev. 2011
Enhanced Neural Recovery: Mind over (Brain) Matter?

• Visual imagery or mental practice of motor skills
• Used in athletics and the arts. Why not stroke rehab?
• PET, fMRI, and EEG evidence of brain activation
Enhanced Neural Recovery: Mental Imagery

- Randomized controlled trial showed improved relearning of common tasks (e.g. use a telephone, sweeping the floor).

Enhanced Neural Recovery research:

- Brain-Computer interfaces
- Nanotechnology
- Primate studies
- DC stim and motor studies
- MR stim
Transcranial mag stim
Neural feedback to enhance robotic rehab
Stroke Rehab
Summary

• Neural plasticity is the basis for several emerging rehab therapies
• Repetition and accuracy of therapy tasks important
• Antidepressants: Treat depression and motor recovery?
• Botulinum injections indicated for spasticity
• New therapies and modalities: Stay tuned
Thank-you