Advances In Stroke Rehabilitation

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Objectives

At the conclusion of this session, you should be able to:

1. Demonstrate understanding of emerging concepts in:
   - Exercise-induced brain repair
   - Neurorehabilitation

2. Describe new technologies used in treatment of stroke

3. Future technologies
Two Converging Sources

1. Advances in understanding of Exercise-Induced Brain Repair

2. New technology-driven treatments
Exercise-Induced Brain Repair

1. Neuroplasticity
2. Neuroprotection
3. Neurorestoration
4. Maintain Blood-Brain Barrier

This is the main target of new rehabilitation strategies
Understanding Brain Repair

• Much active research using advanced imaging technologies
  – PET, SPECT, fMRI, DTI, MRS, MEG

• Application of animal studies to humans

• Improved understanding - new treatment concepts and ideas
Treatment Considerations

• Practice is the biggest factor in neuroplasticity and recovery of function
  – Amount of practice is #1 - More IS better
  – Motivation/engagement
  – Skilled, appropriately graded activity
  – Feedback received
Neuroplasticity Examples

• Reaching with monkeys and rats
  – Skilled movements led to neuroplasticity

From Nudo et al, 1997
Neuroplasticity Examples

• Infants/toddlers and motor learning
  – Toddlers walked an average of 39 football fields per day!
  – Fell an average of 15 times per hour
Practice, Practice, Practice!

Critical number of repetitions:

- Making Eggroll
- Knitting
- Rug-making
- Pearl handling
- Violin playing
- Basketball
- Baseball

~ 1 Million times!!

Free throws: $3/\text{min} \times 60 \text{ mins/hr} \times 10 \text{ hrs/day} = 555 \text{ days of practice}$
Lessons Learned

• What is the primary target of treatment?
  “TRAIN THE BRAIN”

• How do we best accomplish?
  – MASSIVE PRACTICE
  – MAKE IT MOTIVATING
  – SKILLED, CHALLENGING ACTIVITIES
  – PERFORMANCE FEEDBACK
“A New Spin of Old Methods”

- E-stim “bracing” for foot drop
  - Bioness L300,
    Walkaide
- Upcoming:
  - Integration of biofeedback with E-stim
“Gaming” Technologies

• Increased motivation
• Increased feedback
  ➢ Increased practice

• Ability to grade activity difficulty
Wii + Rehabilitation

“Wiihabilitation”
Upper Limb Re-Training

• Constraint Induced Therapy (CIT)
  – Aka “forced use” therapy
  – Can be enhanced with E-stim, orthoses

• Bioness H200
Upper Limb Training

• Reo Therapy – Robot-Assisted Therapy
Upper Limb Neuroprosthesis

- Percutaneous Implantable Neuromuscular Electrical Stimulation (PI-NMES)
- Better for Hemiplegic Shoulder Pain
Computer-Based Cognitive Rehabilitation

Mary
You have EMail from the Chat Group

Please repeat this exercise program 1 time every day:
(average time 15 min)

- Use the glove with the left index finger and rotate the finger 100 degrees.

- Move the index finger up and down in a 80 degree range for 10 times.
Memory Rehabilitation

• Memory Book
• Electronic Memory Aid
  • SenseCam
Locomotion Training

• How do we achieve required practice for walking?
Locomotion Training

- Body-Weight-Supported Treadmill Training (BWSTT)
  - Allows for increased PRACTICE
  - Improved walking motion MAY improve recovery
  - Significant limitations
    - Therapist tolerance!
    - Patient tolerance to harness, unweighting
Locomotion Training

BWSTT

BWSTT
Robotic Treadmill Training

• Addresses limitations of BWSTT
  – Allows for further improved gait motion
  – Therapist tolerance not an issue
  – Can grade activity more objectively

LokoMat
Robotic Treadmill Training

LokoMat Training

After LokoMat
What’s next

• Increased use of robotics
• Increased sophistication of computers
  – More elaborate feedback
• Neuroprosthetics
• Combined technologies
What’s next

- Virtual Reality Systems
What’s next

• Virtual Reality Systems
What’s next

• Brain Neuroprosthetics
Conclusion

- New advances in stroke rehabilitation
- Exercise-induced brain repair
- Upcoming technology for stroke rehabilitation
Questions