Comprehensive Rehabilitation following Stroke: Where we are in 2015

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Presenter Disclosure Information

- Brad Steinle, MD
- Comprehensive Rehabilitation following Stroke: Where we are in 2015.
- I have no financial disclosures to declare.
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- We need to deliver efficient care in a cost-effective manner.
- Interventions such as iv-TPA and clot retrieval are reducing but not always eliminating impairment from stroke.
- Discharge from the hospital and acute rehabilitation following stroke is happening sooner.
- There needs to be coordinated rehabilitation throughout the continuum of care from hospital to community.
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Scope of the problem:

- 795,000 persons have first or recurrent stroke each year in the United States.
- Is the third leading cause of death.
- Is the leading cause of disability.
  - 30 day mortality 8 – 20%.
  - 1 year 15 – 25% 
  - 5 year 40 – 60%
- 4.5 million stroke survivors.
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- Degree of Disability
  - 35% with initial paralysis of the leg does not regain useful function.
  - 20 to 25% are unable to walk without full physical assistance.
  - 65% cannot incorporate the affected hand into their usual activities after six months.
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- **Recovery**
  - 10% spontaneous recovery in 8 – 12 weeks.
  - 10% severe deficits, no significant recovery.
  - 80% with deficits, benefit from *intensive therapy*. 
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- Goals of Therapy
  - Improve functional ability.
  - Improve quality of life.
  - Prevent complications.
  - Restore independence.
  - Decrease costs and need for long term care.
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- Therapy should be started within 24-48 hours upon presentation to the hospital and while the work up is being completed.
- Very early mobilization appears to be safe and feasible.
- Best rehabilitation programs are both multi- and interdisciplinary.

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- Hospital
- Acute rehab
- Outpatient rehab/home health
- Community
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- Rehabilitation Team

The patient!!
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- Rehabilitation Team
  - Physical Therapists – involved with mobility, motor recovery of the lower limb, balance and gait training.
  - Occupational Therapists – involved with self cares, motor recovery of the upper limb, and visual-perceptual deficits.
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- Rehabilitation Team
  - Speech Therapists – involved with evaluation of swallow, communication and cognitive deficits.
  - Rehabilitation Nurses – involved with reinforcing all of the above as well as bladder/bowel management, family-caregiver training.
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- Rehabilitation Team
  - Rehabilitation social workers – Assist with discharge planning. Prepare patient and family for discharge. *Provide counseling.*
  - Nursing assistants – Provide “front-line” assistance with transfers, bladder/bowel management, patient and family education.
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- Rehabilitation Team
  - Neuropsychologists – Cognitive testing. Counseling to patient and family. Assists team with goal setting and management strategies.
  - Vocational specialists – assist with planning to return to work.
  - Driving Specialists – Typically a specially trained P.T. or O.T. Assist with determining competency for driving.
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- Rehabilitation Team
  - Physiatrists – manages medical problems during inpatient and outpatient rehabilitation, manages rehabilitation plan for patient and family and provides “life” counseling for patient and family.
  - Going home is just the first step!!!
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- Rehabilitation of the stroke patient involves two broad concepts:
  - Adaptation or compensation for the existing deficits.
  - Maximizing functional recovery.
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- Brain Plasticity
  - “Since regeneration of transectioned central axons has been convincingly demonstrated in higher mammals, it seems in most instances that one must resort to the assumption that intact fibers take over for the damaged ones”

  Alf Brodal, 1973 Norwegian neuroanatomist
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• Mechanisms of Recovery:
  • Spontaneous – no rehabilitation
    • Motor movement recovery slows after 60 days.
    • ADLs peak at 6 months.
    • Collateral sprouting of axons and dendrites to make new connections.
  • Brain Plasticity
    • Unmasking of neural pathways and synapses.
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• The Concept of Brain Plasticity
  • The somatotrophic organization of the primary motor cortex consists of broad overlapping territories that may contribute to recovery after partial damage.
  • Recovery of motor function may be supported by primary motor neurons originating in premotor and supplementary motor areas.
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- The Concept of Brain Plasticity
  - “The discovery that experience-driven changes in the human brain can occur from a synaptic to a cortical level throughout the life span has been termed a nascent revolution in cognitive neuroscience, overthrowing the long-held belief that the adult brain is hard-wired and resistant to change.”

  Kelly, etal. 2006
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- In other words...
  - Therapy that incorporates specific functional movements and tasks can “turn on” undamaged areas (both adjacent and remote) to take over function of the damaged portion.
  - Directs brain to reorganize or “rewire” itself.
  - Intensity, repetition and consistency of therapy (exercise) is key.
  - Rehabilitation following is a lifelong process!!!
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- Brain Plasticity
  - Can be studied with neuroimaging methods.
    - Positron-Emission Tomography (PET).
    - Functional Magnetic Resonance Imaging (fMRI).
    - Transcranial magnetic stimulation.
    - Magnetoencephalography (MEG).
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- Brain Plasticity
  - An understanding of how experience-induced plasticity occurs helps us understand how to best provide help for our patients who have had stroke or other brain injury.
  - In other words... Understanding what occurs with normal learning through life helps us understand the process of “re-learning” tasks.
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- **Skill acquisition:**
  - Blue Areas – Novel or early activation areas.
  - Red Areas – Task specific activation areas.
  - Green Areas – Late activation areas.
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In other words:

- **Blue Areas** – Learning to throw a ball, kicking a ball.
- **Red Areas** – Becoming more skillful at throwing a ball, kicking a ball.
- **Green Areas** – Expert at throwing a ball, kicking a ball.
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Think about how you have become more skilled at things you do in your life:
- Playing catch.
- Playing the piano.
- Driving.
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Examples:

- Permanent enlargement of the cortical representation area of the left fingers in musical string players.
- Gray matter increases in areas representing navigation-related structures for London taxi drivers.
- Gray matter increases in individuals learning to juggle.
- Conversely, limb amputation is associated with decreased thalamic gray matter, a change thought to reflect the loss of sensory input from a specific body part.
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- In chronic stroke, there is a reconfiguration of the cerebral motor system.
  - Is less effective than that in the intact brain.
  - Will nevertheless attempt to generate motor signals to the spinal cord neurons in the most efficient way.
  - Obviously based on the extent of the anatomical damage.
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This is a comparison of hand control of an unaffected right hand versus affected hemiparetic left hand.

Notice the specific activation areas of the unaffected hemisphere versus the scattered activation of the affected hemisphere.

Figure 2. Comparison between the extent of fMRI activation of the unaffected right hand (focused activation on SMC; IndexHEM=1.0, IndexSMC=1.0) and affected left hand (recruitment of ipsilateral SMC, frontal premotor areas, and SMA; IndexHEM=0.01, IndexSMC=0.14) in patient 11-HEM (M1lesioned). First fMRI session was 1 month after stroke. Statistical thresholds are the same for both hands (P<0.0001). White arrow shows small lesion involving the M1 hand representation.
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The investigational group underwent 8 weeks of CIMT and demonstrated more specific activation on fMRI which was associated with improved hand control. The control group showed no activation changes with no associated change in hand control.
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- What are the implications for rehabilitation?
  - Early and intensive therapy is appropriate.
  - Multiple techniques are currently being studied.
  - Repetition of movement may be the most important factor.
  - Ability to identify factors that lead to optimal recovery is lacking.
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- Learned Nonuse
  - Unused body systems undergo cellular, metabolic and structural changes which over time are interpreted by the CNS as the norm.
  - Learned nonuse results in decreased recovery and function of the limb.
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- Constraint Induced Movement Therapy (CIMT)
  - Program involves “restraining” unaffected arm for most of waking hours with therapy that consists of progressively more difficult tasks.
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- Constraint Induced Movement Therapy (CIMT)
  - In studies examining CIMT on fMRI activation, treatment-associated increases were seen within the ipsilesional primary motor cortex, dorsal premotor cortex, and supplementary motor area.
  - Most study results support the view that performance improvements found in CIMT were associated with a reconfiguration of the motor network that is similar to that identified in health age-matched controls.
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- New Technologies:
  - Serve to enhance quality of movement or provide sensory feedback of movement.
  - Serve to increase intensity or frequency of the movement.
  - Serve to improve functionality with daily tasks.
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Bioness L300 (+)  Walk Aide

These devices have been shown to improve gait velocity, physical function and participation in community life.

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**Bioness H200**

Provides functional electrical stimulation (FES) sequentially activate muscle groups in the forearm to produce functional movement patterns in hand (grasp and release).

Upper limb task-oriented training that begins soon after stroke that incorporates FES may improve functional use in patient with mild/moderate paresis.

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Robotic arm takes patient through a range of motion with variable level of assist depending on degree of paresis with the patient getting visual feedback on movement through a computer screen.

Meta-analysis showed significant improvement in upper limb function without significant improvement of ADL function.

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Walking with body weight support is feasible, safe and tends to result in more people walking independently and earlier after stroke.

Lite Gait

Solo Step

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VR Wii gaming technology represents a safe, feasible and potentially effective alternative to facilitate rehabilitation therapy and promote motor recovery after stroke.

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Saeboflex is used to assist wrist and finger extension. Aids in release of grasp. Shown to benefits essentially in case series and case studies.
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• Case #1
• JM is a 34 yo RH male who developed right arm and leg weakness while at work as a highway patrolman.
• He was life flighted to SLH and underwent successful clot retrieval.
• Unfortunately over the next 24 hours developed brain swelling and required rescue craniectomy.
• He had prolonged ICU care – trach, PEG.
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- Case #1
- Was able to be weaned from vent.
- When medically ready, he was sent to acute rehab.
- At that time, he had expressive aphasia, R HP (arm 1-2/5; leg 2-3 /5).
- He had a 5 week stay on the rehab unit.
- He had 2 interruptions during stay:
  - Bone flap replacement.
  - Appendectomy.
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- **Case #1**
  - The 4 days he was off DVT prophylaxis he developed PE.
  - Despite this, he was able to discharge to home (3 days after his wife delivered twin boys). At that time, communication had improved, right arm was 3-4/5; right leg 4/5.
  - He traveled to SLH outpatient therapy for 6 weeks.
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- Case #1
- He has developed spasticity in the right arm and has undergone botulinum injection.
- He was eventually transitioned to therapy in his home town.
- He underwent driving evaluation at R!KC and successfully passed.
- He is working with Missouri Vocational Rehabilitation for return to work opportunities.
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- Case #2

- BT is a 62 yo RH male who was admitted SLH with left arm and leg weakness. Unfortunately, he woke up with the weakness and outside the window for intervention.

- He had left visual inattention, left hemiparesis (arm 1-2/5; left leg 2-3/5); left hemisensory neglect.

- After 4 days, he was admitted to acute rehab.

- He made some progress with therapy and was discharged to home after 4 weeks using a wheelchair.
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- Case #2

- He did several weeks of home health therapy and was then discharged to R!KC day rehab program.

- He spent approximately 8 weeks in their program. He did not gain much function in the left arm; he was walking with cane and left AFO.

- He was referred to the R!KC driving program and failed their program.

- He started the American Stroke Foundation program – a wellness program for stroke.
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• Case #2

• He participated in the stroke walk – was their biggest fund raiser one year.

• He took the driving program at Shawnee Mission Medical Center and failed their program.

• He “conned” a physiatrist” in his neighborhood to work with him on driving a golf cart in subdivision.

• Approximately one year later, he was sent back to R!KC for “pre-driving” work.
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- Case #2
- Somehow he passed the driving test the third time he took it.
- He has volunteers at SLH.
- He travels to Florida every winter.
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- Rehabilitation is an essential part of a comprehensive stroke program.
- Early initiation of therapy is safe and feasible.
- The program must be multi- and interdisciplinary.
- Keys to improvement are intensity and frequency.
- New technologies hold promise to aid in achieving intensity and frequency.
- The therapy (exercise) should be considered a lifetime activity.
Questions???

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