

## Stroke Rehabilitation: A Quick Review of Motor Recovery, Shoulder Pain and Depression



Sean Dukelow MD PhD FRCPC  
Calgary Stroke Program  
Division of Physical Medicine and Rehabilitation  
Department of Clinical Neurosciences  
University of Calgary

## Objectives

- \* 1) Review Motor Recovery following Stroke
- \* 2) Review Common Causes of Post-Stroke Shoulder pain and their treatments
- \* 3) Review Post-Stroke Depression

## Case # 1

- \* 22 year old male with ischemic stroke in the right internal capsule of undetermined origin (despite multiple investigations)
- \* Medically stable, hemiplegic, minimal spasticity, intact cognition, sensation, vision and language
- \* Chedoke McMaster Stroke Impairment Scale of 3 in the upper extremity, 5 for the lower extremity

## Motor Recovery Following Stroke

- \* **Mechanisms of Recovery**
- \* Early - local CNS Processes: Resolution of edema, ischemic penumbra, diaschisis
- \* Later - CNS Reorganization: neurotransmitter alterations, unmasking of alternate pathways, synaptogenesis

Ref: EBRSR 10<sup>th</sup> Edition

## Motor Recovery Following Stroke

- \* **General Timelines for Stroke Recovery - Copenhagen Stroke Study (Jorgenson et al., 1995)**
- \* Community based population of 1197 patients admitted to a 63 bed stroke unit, classified impairment with the Scandinavian Neurological Stroke Scale and disability with the Barthel Index - mean age 73.3 years
- \* 95% with mild strokes had max. neurologic recovery in 6 weeks
- \* 95% of moderate strokes had max. neurologic recovery in 10 weeks
- \* 95% of severe strokes had max. neurologic recovery in 15 weeks
- \* 95% of very severe strokes had max neurologic recovery in 13 weeks
- \* Neurologic recovery, on average, occurred about 2 weeks before functional recovery

## Motor Recovery Following Stroke

- \* **Recovery of the Lower Extremity**
- \* Jorgensen et al. (1995) - mean age 74.5
- \* Best walking function reached within 4 weeks for mild paresis
- \* 6 weeks for moderate paresis
- \* 11 weeks for severe paralysis
- \* The time course of neurologic and functional recovery was strongly related to both initial stroke severity and disability

## Motor Recovery after Stroke

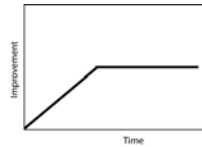
- \* **Recovery of the Lower Extremity**
- \* Dobkin (1997) – 800 acute stroke patients – at baseline 51% were unable to walk, 12% walked with assistance, 37% were independent walkers
- \* By discharge 22% couldn't walk, 14% walked with assistance, 64% were independent walkers
- \* 80% of non-walkers achieved best walking function by 6 weeks and 95% by 11 weeks

## Motor Recovery after Stroke

- \* **Recovery of the Upper Extremity**
- \* About 14% of patients experience complete motor recovery, while about 30% achieve partial recovery (Nakayama et al. 1994)
- \* Dobkin (1997) – best upper extremity function on Barthel Index (grooming and feeding) was achieved by 95% of patients in 9 weeks
- \* Mild paresis improved by 6 weeks, severe paresis reached best function by 11 weeks
- \* Barreca et al. (2001) recommended that with a CMSS < 4, treatment should focus on minimizing contractures and pain

## Motor Recovery Following Stroke

- \* **What about the Plateau?**
- \* When stroke patients have a plateau in functional status, they remain relatively stable between 6 months and 3 years (Stineman and Granger, 1991)
- \* Newer trials on things such as constraint induced movement therapy or robotic therapy have challenged this a bit, demonstrating that even chronic stroke patients can demonstrate significant improvements (Wolf et al. 2006, Posteraro et al. 2009)



## Motor Recovery Following Stroke

- \* **What is actually happening to the Brain in Rehab?**
- \* Animal raised in complex or enriched environments have thicker cortical tissue, greater neuron size, greater degree of dendritic branching, more and larger synapses
- \* Cortical representations of the extremities will expand or contract based on use (or lack of) (Kolb, 2003)



## Motor Recovery Following Stroke

- \* **What is actually happening to the Brain in Rehab?**
- \* In humans with stroke – one might consider neurological recovery synonymous with motor re-learning
- \* In healthy humans practicing things like a sequence of finger movements can increase cortical representation
- \* In functional imaging studies on stroke patients, researchers have observed a) bilateral motor cortex activity (Bury and Jones, 2002; Cramer, 2003) b) increased recruitment of secondary cortical areas (Cramer, 2003) c) recruitment along the cortical rim of the infarct (Cramer, 2003)



## Motor Recovery Following Stroke

- \* **When to start stroke rehabilitation?**
- \* Some animal studies have shown detrimental effects of starting too soon – within the first few days after a stroke
- \* However, animal studies have also indicated that earlier therapy results in increased cortical reorganization (after day 5 post-stroke)

1...2...3...GO!

## Motor Recovery Following Stroke

- \* **The Role of Intensity**
- \* More hours and greater frequency of therapy = better recovery (Kwakkel et al., 1997, 1999; Langhorne et al. 1996, Teasell et al. 2004)
- \* More intensive therapy = better functional outcomes, reduced hospital stays (Kalra, 1994)

## Motor Recovery Following Stroke

- \* **Does the size of the lesion matter?**
- \* Animals with larger lesions show less return of function and require more compensatory behaviours (Kolb, 1995)
- \* In humans, Hier et al. (1983) showed earlier recovery was associated with lesions measuring less than 6% of the right hemisphere volume and parenchymatous hemorrhage

## Motor Recovery Following Stroke

- \* **Does Age matter?**
- \* In humans age has an influence on the speed and completeness of recovery (Kugler et al. 2003; Bagg et al. 2002)
- \* Younger patients tend to recover faster and more completely

## What does this mean for our case #1?

- \* He's young so he should recover more completely
- \* At 2 months post stroke, he's still on the recovery curve
- \* At only 2 hours per week of outpatient therapy, he's probably "under-dosed"
- \* Despite the fact his CMSS was 3 (out of 7), he's improving

## Case #2

- \* 60 year old woman with ischemic, cortical right middle cerebral artery stroke
- \* Medically stable, moderate hemiplegia, mild spasticity (Modified Ashworth grade 1), normal language, cognition and visual fields
- \* 5 weeks post-stroke, complaints of left sided shoulder pain

## Case # 2

- \* Initially exam shows limited active ROM in the shoulder, but full passive ROM
- \* However she gets pain in abduction or flexion greater than 90 degrees and in external rotation
- \* Initially we felt she had subluxation of the shoulder and treated accordingly, additionally there was some tendonitis

## Post-Stroke Shoulder pain

- \* Incidence estimates of post-stroke shoulder pain range from 48 – 84% (Najenson et al. 1971; Poulin de Courval et al. 1990)
- \* Shoulder pain can result in significant disability (Najenson et al. 1971, Poduri, 1993)
- \* Onset of shoulder pain 2-3 months post-stroke is more typical (Poduri 1993)

## Post-Stroke Shoulder Pain

Anatomical Site	Mechanism
Muscle	Rotator Cuff, Muscle Imbalance, Subscapularis or Pectoralis Spasticity
Bone	Humeral Fracture
Joint	Glenohumeral subluxation
Bursae	Bursitis
Tendon	Tendonitis
Joint Capsule	Frozen Shoulder, Adhesive Capsulitis
Other	Shoulder Hand Syndrome

Reference: EBRSR, 10<sup>th</sup> Edition

## Post-Stroke Shoulder Pain

- \* **The Common Causes**
  - \* 1) Shoulder Subluxation
  - \* 2) Spasticity
  - \* 3) Frozen Shoulder
  - \* 4) Complex Regional Pain Syndrome
  - \* 5) Rotator Cuff Tear
  - \* 6) Subacromial Impingement/Rotator Cuff Tendonitis

## Post-Stroke Shoulder Pain

### 1) Shoulder Subluxation

- \* Due to a loss of muscle tone in the hemiplegic arm and because of the weight of the arm and the pull of gravity – the humeral head effectively pulls away from its socket (the glenoid fossa)

## Post-Stroke Shoulder Pain

- \* Shoulder Subluxation Photograph (posterior)
- \* Note the "squaring off" of the shoulder



## Post-Stroke Shoulder Pain

- \* Shoulder Subluxation Photograph (anterior)
- \* A low tone, unsupported arm will cause this kind of subluxation



## Post-Stroke Shoulder Pain

- \* Is Shoulder Subluxation always Painful?

### • Studies Supporting the Role of Shoulder Subluxation in Pain

- Shai et al. 1984
- Van Ouwenaller et al. 1986
- Poulin de Courval et al. 1990
- Roy et al. 1994
- Chantraine et al. 1999
- Lo et al. 2003
- Aras et al. 2004

### • Studies *Which Fail* to Support the Role of Shoulder Subluxation in Pain

- Peszczynski & Rardin 1965
- Bohannon 1988
- Van Langenberghe & Hogan 1988
- Bohannon & Andrews 1990
- Kumar et al. 1999
- Arsenault et al. 1991
- Joynt 1992
- Zorowitz et al. 1996
- Ikai et al. 1998

From EBRSR 10<sup>th</sup> Edition

## Post-Stroke Shoulder Pain

- \* Preventing Post-Stroke Shoulder pain

### \* *Proper Handling*

- \* Move the arm only in the pain free range

### \* *Protection*

- \* Avoid passively lifting the arm higher than shoulder level
- \* Avoid lifting from under arm or pulling on arm

### \* *Proper Positioning*

- \* Position the shoulder and shoulder blade in a protracted position

### \* *Support*

- \* Pillows, lap trays, slings

## Post-Stroke Shoulder Pain

### \* **Shoulder Supports**

- \* Can help prevent subluxation and pain
- \* Limited evidence that one device is any better than another
- \* Once a support has been chosen by the therapy team, its important that all the team members "support" its use



## Post-Stroke Shoulder Pain

### 2) Spasticity

- \* Velocity-dependent resistance to movement, associated with high muscle tone, increased reflexes and clonus
- \* Spasticity of the subscapularis and pectoralis muscles (Braun et al. 1984; Caldwell et al. 1969; Moskowitz, 1969) is thought to cause post-stroke shoulder pain
- \* If left untreated it can lead to contracture (also associated with shoulder pain)

## Post-Stroke Shoulder Pain

### \* **Spasticity - Treatment**

- \* First recognize there is a problem with spasticity
- \* Conservative management includes gentle ROM, positioning, splinting, alleviating triggers – bladder, bowels, skin ulcers
- \* Medications – either oral (eg. Baclofen) or injectable (eg. Botulinum toxin) (Lim et al. 2008)

## Post-Stroke Shoulder Pain

### 3) Frozen Shoulder (A.K.A. Adhesive Capsulitis)

- \* Presents initially with pain and then decrease in shoulder ROM (active and passive) at the glenohumeral joint
- \* One author reported an incidence of 50% in post-stroke painful shoulder (Lo et al. 2005)
- \* Often divided into three phases 1) the painful phase 2) the stiffening phase 3) the thawing phase (Pearsall, 2008)
- \* Higher incidence in patients with diabetes

## Post-Stroke Shoulder Pain

- \* **Frozen Shoulder – Treatment**
- \* ROM
- \* Subacromial vs. intra-articular corticosteroid injection (Lee et al., 2009)
- \* Short course of prednisone
- \* NSAIDs
- \* Manipulation under anesthesia (Flannery et al. 2007)

## Post-Stroke Shoulder Pain

### 4) Complex Regional Pain Syndrome (AKA Shoulder Hand Syndrome, RSD)

- \* Incidence is reported between 12-34%
- \* Often presents with pain in the shoulder, followed by a painful, edematous hand and wrist – decreased ROM at the shoulder and hand while the elbow is spared
- \* Gold standard diagnostic test is triple-phase bone scan

## Post-Stroke Shoulder Pain

- \* **Complex Regional Pain Syndrome – Treatment**
- \* Prevention – early ROM, avoid subluxation
- \* Therapy – ROM, Modalities (contrast baths), TENS
- \* Medication – analgesics, NSAIDs, High Dose oral corticosteroids (10 day course)
- \* Injections – stellate ganglion blocks
- \* Surgical - sympathectomy

From EBRSR 10<sup>th</sup> Edition

## Post-Stroke Shoulder Pain

### 5) Rotator Cuff Tear

- \* Tear in one of the muscles that support the humerus in the glenoid (usually supraspinatus)
- \* The tear is painful and decreases ROM
- \* Lo et al. 2005 reports only 4% of their sample of stroke patients had tears, but other studies (Nejenson et al. 1971) were as high as 40%
- \* Diagnosis can be made by physical exam, imaging (Ultrasound/MRI)

## Post-Stroke Shoulder Pain

- \* **Rotator Cuff Tear – Treatment**
- \* Prevention
- \* Rest
- \* Analgesia
- \* Surgical opinion

## Post-Stroke Shoulder Pain

### 6) Subacromial Impingement/Supraspinatus tendonitis/Subacromial Bursitis

- \* Compression of the rotator cuff tendons and the subacromial bursae between the humeral head and the coracoacromial arch
- \* Typically presents with painful arc, occasionally a rotator cuff tear

## Post-Stroke Shoulder Pain

- \* **Subacromial Impingement/tendonitis – Treatment**
- \* Rest
- \* Ice
- \* NSAID's
- \* Corticosteroid Injection (Chae et al., 2007, 2009)

## A return to Case #2

- \* At 12 weeks post-stroke she returns to my outpatient clinic, she no longer uses the recommended support
- \* The pain in her shoulder has diminished
- \* However, she only has 60 degrees of flexion and abduction in passive or active movement. There is not detectable glenohumeral movement on my exam. What has happened?

## Case #3

- \* 70 year old male, ischemic stroke in the left internal capsule
- \* moderate hemiplegia, intact vision, sensation, cognition, language
- \* 4 weeks post stroke, progressed well with rehabilitation then a relatively sudden decline
- \* Staff noticed progressively worsening cognition, motor recovery plateau and then regressed
- \* Staff performed a series of laboratory investigations (Blood work, blood and urine cultures, CT head) to identify a cause and all were within normal limits

## Post-Stroke Depression

- \* **The Numbers....**
- \* Prevalence – 33% (Spalletta et al., 2009)
- \* Age >65 and stroke within 24 months have a 6 times greater risk than stroke-free counterparts (Whyte et al., 2004)
- \* The literature will discuss major depressive-like episodes and minor depression
- \* It's been recommended that the DSM-IV criteria be used for diagnosis (Spalletta et al. 2005), despite the fact that symptoms may relate to the physical illness

## Post-Stroke Depression

- \* **Timing**
- \* Peak frequency at 3 to 6 months after stroke and decline thereafter (Robinson et al., 1987)
- \* Onset of depression (within a few weeks) seems to go with spontaneous remission, while onset on after 7 weeks is associated with a lower risk of spontaneous recovery (Andersen, 1994)

## Post-Stroke Depression

- \* **Risk Factors**
- \* Female
- \* Past history of depression or psychiatric illness
- \* Social isolation
- \* Functional impairment
- \* Cognitive impairment

## Post-Stroke Depression

- \* **What's the Impact?**
- \* Negative impact on functional recovery (Robinson et al., 1987)
- \* Increased cognitive impairment
- \* Increased risk of mortality (Morris et al, 1993; Everson et al, 1998)

## Post-Stroke Depression

- \* **Treatment Options (Medications)**
- \* Heterocyclic Antidepressants (eg. Imipramine 50-150mg/day, Lauritzen et al., 1994))
- \* Selective Serotonin Reuptake Inhibitors (SSRIs) (eg. Citalopram 20-40mg/day, Andersen et al., 1994)
- \* Serotonin Norepinephrine Reuptake Inhibitor (SNRI) (eg. Venlafaxine)
- \* Recommended treat for 6 months

## Post-stroke Depression

- \* **Treatment Options (other)**
- \* Electroconvulsive therapy (Murray et al. 1986)
- \* Transcranial Magnetic Stimulation (Jorge et al. 2004)
- \* Psychosocial Behavioural Therapy (Mitchell et al. 2009)
- \* Cognitive Behavioural Therapy (doesn't typically work) (Lincoln et al. 1997, 2003)

## Case # 3

- \* Started on an SSRI (Citalopram)
- \* Made very slow improvement in affect and function

## Motor Recovery - Take home Points

- \* Motor recovery following stroke
  - \* Younger patients may recover more fully
  - \* Most people will walk again, but fewer will have functional use of their hand
  - \* The more severe the stroke and the older the patient, the slower the recovery

## Post-Stroke Shoulder Take Home Points

- \* Post-Stroke Shoulder Pain
  - \* There are many different causes of post-stroke shoulder pain, each requires differential assessment and treatment
  - \* Many causes of post-stroke shoulder pain can be prevented

## Post-Stroke Depression Take Home Points

- \* Post-stroke depression is common
- \* Prompt evaluation and treatment is important to help the patient gain the most from his/her rehabilitation

## For Further Reading:

- \* Evidence Based Review of Stroke Rehabilitation ([www.ebrsr.com](http://www.ebrsr.com))
- \* Stroke Recovery and Rehabilitation, Stein, Harvey, Macko, Winstein, Zorowitz, 2007, Demos Medical.

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