

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 10th 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

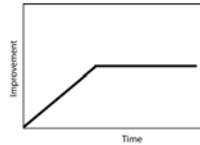
- * **Recovery of the Lower Extremity**
- * Dobkin (1997) – 800 acute stroke patients – at baseline 51% were unable to walk, 12% walked with assistance, 37% were independent walkers
- * By discharge 22% couldn't walk, 14% walked with assistance, 64% were independent walkers
- * 80% of non-walkers achieved 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, 10th 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 10th 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 10th 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)
- * Stroke Recovery and Rehabilitation, Stein, Harvey, Macko, Winstein, Zorowitz, 2007, Demos Medical.

References (in the order they appeared)

- * Jorgensen et al. 1995. Outcome and time course of recovery in stroke. Part I: Outcome. The Copenhagen Stroke Study. Arch Phys Med Rehabil. 76, 399-405.
- * Jorgensen et al. 1995. Outcome and time course of recovery in stroke. Part II: Time course of recovery. The Copenhagen Stroke Study. Arch Phys Med Rehabil. 76, 406-412.
- * Jorenesen et al. 1995. Recovery of walking function in stroke patients: the Copenhagen Stroke Study. Arch Phys Med Rehabil. 76:27-32.
- * Dobkin et al. 1997. Impairments, disabilities, and bases for neurological rehabilitation after stroke. Journal of Stroke and Cerebrovascular diseases. 6: 221-226.
- * Nakayama et al. 1994. Compensation in recovery of upper extremity function after stroke: the Copenhagen Stroke Study. Arch Phys Med Rehabil. 75: 852-857.

References

- * Barreca et al. 2001. Management of the Post Stroke Hemiplegic Arm and Hand: Treatment Recommendations of the 2001 Consensus Panel. Heart and Stroke Foundation of Ontario.
- * Stineman and Granger. 1991. Epidemiology of stroke-related disability. In: Goldbert G (ed). Stroke Rehabilitation. Physical Medicine and Rehabilitation Clinics of North America. 2(3):457-471.
- * Wolf et al. 2006. Effect of constraint-induced movement therapy on upper extremity function 3 to 9 months after stroke: the EXCITE randomized clinical trial. JAMA. 296(17): 2095-104.
- * Posteraro et al. 2009. Robot-mediated therapy for paretic upper limb of chronic patients following neurological injury. J Rehabil Med. 41(12):976-80.
- * Kolb. 1995. Brain plasticity and behaviour. Erlbaum Mahwah, NJ.

References

- * Kolb. 2003. Overview of cortical plasticity and recovery from grain injury. Phys Med Rehab Clin N Am. 14(1 Suppl):S7-S25, vii.
- * Bury and Jones. 2002. Unilateral sensorimotor cortex lesions in adult rats facilitate motor skill learning with the "unaffected" forelimb and training-induced dendritic structural plasticity in the motor cortex. J Neurosci. 22(19):8597-606.
- * Cramer. 2003. Functional magnetic resonance imaging in stroke recovery. Phys Med Rehabil Clin N Am. 14(1 Suppl):S47-S55.
- * Kwakkel et al. 1997. Effects of intensity of rehabilitation after stroke. A research synthesis. Stroke. 28(8):1550-1556.
- * Kwakkel et al. 1999. Intensity of leg and arm training after primary middle-cerebral-artery stroke: a randomized trial. Lancet. 354(9174):191-196.
- * Langhorne et al. 1996. Physiotherapy after stroke: more is better? Physiother Res Int. 1(2):75-88.
- * Teasell et al. 2004. Evidence-based review of stroke rehabilitation. 5th Ed. London, Ontario.
- * Kalra. 1994. Does age affect benefits of stroke unit rehabilitation. Stroke. 25(2):346-351.

References

- * Kugler et al. 2003. Hessian Stroke Data Bank Study Group ASH. Does age influence early recovery from ischemic stroke? A study from the Hessian Stroke Data Bank. J Neuro. 25(6):674-681.
- * Bagg et al. 2002. Effect of age on function outcomes after stroke rehabilitation. Stroke. 33(1):179-185.
- * Ne Jensen et al. 1991. Rotator cuff injury in hemiplegic patients. Scand J Rehab Med. 2:131-137.
- * Poulin de Courval et al. 1990. Painful shoulder in the hemiplegic and unilateral neglect. Arch Phys Med Rehabil. 71(9):673-6.
- * Podari. 1993. Shoulder pain in stroke patients and its effects on rehabilitation. J Stroke Cerebrovasc Dis. 3:261-266.
- * Braun et al. 1984. Surgical treatment of the painful shoulder contracture in the stroke patient. J Bone Joint Surg (Am). 53:1307-1312.
- * Caldwell et al. 1969. Evaluation and treatment of the upper extremity in the hemiplegic stroke patient. Clin Orthop. 63:69-93.
- * Moskowitz. 1969. Complications in rehabilitation of hemiplegic patients. Med Clin North Am. 53:541-559.
- * Lo et al. 2005. Arthrographic and clinical findings in patients with hemiplegic shoulder pain. Arch Phys Med Rehabil. 84:1786-1791.

References

- * Lin et al. 2008. Intramuscular botulinum toxin A reduces hemiplegic shoulder pain: a randomized, double-blind, comparative study vs. intramuscular bismacrobane acetamide. *Stroke*. 39(1): 126-31.
- * Pearsall. 2008. Adhesive Capsulitis. <http://emedicine.medicape.com/article/1261598-overview>
- * Lee et al. 2009. Randomized controlled trial for efficacy of intra-articular injection for adhesive capsulitis: ultrasonography-guided versus blind technique. *Arch Phys Med Rehabil*. 90(12):1997-2002.
- * Flannery et al. 2007. Adhesive shoulder capsulitis: does the timing of manipulation influence the outcome? *Acta Orthop Scand*. 73(1):21-5.
- * Chae et al. 2007. Subacromial corticosteroid injection for poststroke shoulder pain: a retrospective chart review. *Arch Phys Med Rehabil*. 88(13):1696-3.
- * Chae et al. 2009. Subacromial corticosteroid injection for poststroke shoulder pain: an exploratory prospective case series. *Arch Phys Med Rehabil*. 90(3): 501-4.
- * Najenson et al. 1971. Rotator cuff injury in hemiplegic patients. *Scand J Rehab Med*. 55:49-51.

References

- * Spaletta et al. 2005. Symptom profile of DSM-IV major and minor depressive disorders in first-ever stroke patients. *Am J Geriatr Psychiatry*. 13(2):108-115.
- * Spaletta et al. 2009. Depression and other Neuropsychiatric Complications. 453-457, Ch 27. In *Stroke Recovery and Rehabilitation*. Stein et al. (Ed). Demos Medical, NY.
- * Robinson et al. 1987. Two-year longitudinal study of post-stroke mood disorders: Diagnosis and outcome at one and two years. *Stroke*. 18(5):837-843.
- * Andersen. 1994. Effective treatment of post-stroke depression with selective serotonin reuptake inhibitor citalopram. *Stroke*. 25:1099-1104.

References

- * Morris et al. 1992. Clinical depression is associated with impaired recovery from stroke. *Med J Aust*. 157:239-242.
- * Everson et al. 1998. Depressive symptoms and increased risk of stroke mortality over a 29-year period. *Arch Intern Med*. 158:1133-1138.
- * Lauritzen et al. 1994. Post-stroke depression combined treatment with imipramine or desipramine and mianserin: A controlled clinic study. *Psychopharmacology*. 114:119-122.
- * Murray et al. 1986. Electroconvulsive therapy for poststroke depression. *J Clin Psychiatry*. 47:258-260.
- * Jorge et al. 2004. Repetitive Transcranial Magnetic Stimulation as treatment for poststroke depression: a preliminary study. *Biol Psychiatry*. 44:398-405

References

- * Mitchell et al. 2009. Brief Psychosocial behavioural intervention with antidepressant reduces poststroke depression significantly more than usual care with antidepressant: living well with stroke: randomized, controlled trial. *Stroke* 2009. 40(9):3073-8.
- * Lincoln et al. 1997. Evaluation of cognitive behavioural treatment for depression after stroke: a pilot study. *Clinical Rehabilitation*. 11:114-122.
- * Lincoln et al. 2003. The validity of questionnaire measures for assessing depression after stroke. *Clinical Rehabilitation*. 17:840-846.