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### Post-Stroke Pain

- Up to 70% of patients exhibit post stroke pain; 50% of these experience it daily (Naess et al., *Vasc Health Risk Manag*; 2012).
- Triggered by peripheral/mechanisms (soft tissue changes; musculoskeletal changes), psychological factors, autonomic factors and/or central poststroke pain, d/t primary central nervous system (CNS) mechanisms/changes.
  - Pain d/t musculoskeletal change – most frequent cause/majority of cases
- Nervous system pain
  - Central post stroke pain
    - Neuropathy– results from diabetes (which is usually a result of stroke)
  - Peripheral pain
    - Complex Regional Pain Syndrome (CRPS) - formerly known as RSD; shoulder-hand syndrome

O'Donnell MJ, Diener HC, Sacco RL, et al. *Stroke*; 2013

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## Stroke Survivors With Pain...

- ...experience greater cognitive and functional decline (O'Donnell et al., 2013)
- ...experience lower quality of life (Hoang et al., 2012)
- ...experience fatigue (Hoang et al., 2012)
- ...experience depression (Lundström, et al., 2009)
- PSP is a predictor of suicidality after stroke (Tang et al., 2013)

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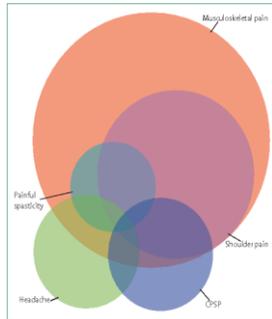
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## The Origin of the Pain Is Hard to Identify, Making It Harder To Treat!

- Patients can have various combinations of one or several pain types (overlapping areas)
- Spasticity 7%, CPSP 10%, shoulder pain 20%, musculoskeletal pain 40%
- A moving target:
  - Maladaptive plasticity co-occurring: de-afferentation and neuronal hyperexcitability
  - Progression/Worsening of conditions




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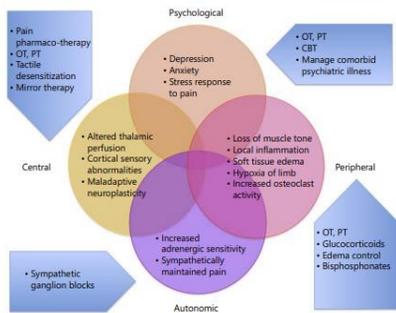
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## What Do We Generally Throw at Post Stroke Pain?



Harrison & Field, *Cerebrovasc Dis*; 2015

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## Neuropathic Pain

Pain associated with Central Nervous System and Peripheral Nervous System

Central Post Stroke Pain (CPSP) (a.k.a., "Thalamic Pain"):  
A Generalized Pain

Peripheral Nervous System - Complex Regional Pain Syndrome (CRPS) (a.k.a., "RSD," "Shoulder Hand Syndrome")

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### OCCURRENCE

#### Central Nervous System Pain/ Generalized Pain

- 1-25% of all stroke survivors (Klit et al., Table 1; 2009; *Lancet Neurol*)
  - two-thirds of those with central pain had inadequate pain treatment, or were prescribed no treatment at all! (Widat et al., 2002)
- Difficult to diagnose →
  - May be described as aching, dull, and throbbing to sharp, stabbing, shooting, or burning pain. (Nicholson, 2004)
- Difficult to diagnose →
  - Can be exacerbated by normal activities (allodynia; e.g., physical movement)
  - Or increased sensation to uncomfortable stimuli (hyperalgesia, e.g., emotional stress, loud noises or voices, changes in the weather, cold, and light touch (Bowie et al. 1989; Leijon et al., 1989a, Tasker 1990)).
- Difficult to predict when it will occur:
  - Latency varies; more common > 6 mos (Kumar et al., 2009)

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Sir Henry Head: severing and reconnecting sensory nerves and mapping how sensation returned over time

### Who Gets Central Nervous System Pain?

- Previous history of depression, greater stroke severity, younger age, and smoking (O'Donnell, et al, 2013)
- People with strokes affecting the parietal lobe.
- People w strokes affecting the right hemisphere are more commonly associated with pain
- Head and Holmes: injury to the sensory pathways causes a compensatory overactivation within the thalamus, causing spontaneous pain (allodynia) (Head & Holmes, 1911).
  - Some parts of the sensory tract remain intact; neuronal excitability also occurs in others (Hong et al., 2012)

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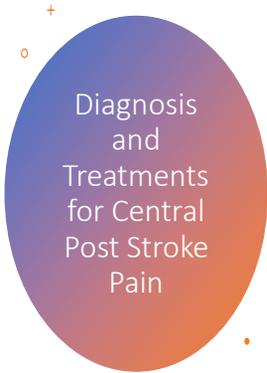
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#### DIAGNOSIS:

Verbal Descriptors Used: lacerating, aching, burning, freezing, squeezing  
 Spontaneous dysesthesia  
 Allodymia to touch and mild temperatures  
 Variable pain quality  
 Abnormal sensitivity to pinprick and high temperatures  
 Raised thresholds for perception of touch and two-point discrimination

#### TREATMENTS:

- Anticonvulsants (e.g., gabapentin)
- Antidepressants (SSRIs)
- Deep brain stimulation (thalamus)
- rTMS
- Acupuncture/Acupressure

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### Complex Regional Pain Syndrome (CRPS)

- Used to be called "reflex sympathetic dystrophy (RSD)," "causalgia," "Sudeck's atrophy," or "shoulder-hand syndrome."
- Pain, edema, vasomotor changes, and patchy bone demineralization of the more affected extremity.
- Between 2 and 49% of all stroke survivors have CRPS (Yes; really) (Kocabas, 2009)
  - Hard to diagnose
  - Patients not necessarily seeing rehab specialists when it emerges




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### CRPS Symptoms and Types

- Unprovoked or spontaneous pain that can be constant or fluctuate with activity
- Excess or prolonged pain after use or contact
- Changes in skin temperature, skin color, or swelling of the affected limb.
- Changes in skin texture
- Abnormal sweating and nail and hair growth
- Excess bone growth or bone mineral density change
- Impaired muscle strength and movement

Types:

Type I: more common; there is no definable nerve lesion. Most stroke patients fall here.

Type II: (also called "causalgia") definable nerve lesion or trauma is present.

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### CRPS Progression

Stages and symptoms of CRPS (Adopted from Iwata et al. 2002)

Stage	Symptoms
1	<ul style="list-style-type: none"> <li>• Persistent pain, described as burning or aching</li> <li>• Extremity is edematous, warm, and hyperesthetic</li> <li>• Pain is aggravated by movement</li> </ul>
2	<ul style="list-style-type: none"> <li>• Early dystrophic changes in the limb</li> <li>• Atrophy of the muscle and skin</li> <li>• Vasospasm with hyperhidrosis</li> </ul>
3	<ul style="list-style-type: none"> <li>• Soft-tissue dystrophy</li> <li>• Contractures that produce frozen shoulder</li> <li>• Pain and vasomotor changes are infrequent</li> </ul>

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## CRPS Diagnosis: The Budapest Criteria

Continuing pain, which is disproportionate to any inciting event.

Must report at least **one** symptom in all four of the following categories:

- sensory – reports of hyperaesthesia and/or allodynia
- vasomotor – reports of temperature asymmetry and/or skin colour changes and/or skin colour asymmetry
- sudomotor/oedema – reports of oedema and/or sweating changes and/or sweating asymmetry
- motor/trophic – reports of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin).

Must display at least **one** sign at time of evaluation in two or more of the following categories:

- sensory – evidence of hyperalgesia (to pinprick) and/or allodynia (to light touch and/or temperature sensation and/or deep somatic pressure and/or joint movement)
- vasomotor – evidence of temperature asymmetry (>1 °C) and/or skin colour changes and/or asymmetry
- sudomotor/oedema – evidence of oedema and/or sweating changes and/or sweating asymmetry
- motor/trophic – evidence of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)

There is no other diagnosis that better explains the signs and symptoms.

Goebel, 2017

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## You may have CRPS if...

- You have subluxation (Dursun E, 2000)
- High degree of weakness and immobility in the shoulder (Gokkaya, 2006)
- Trauma to the affected shoulder (Chae, 2010)
- MCP tenderness was the single best diagnostic indicator; Sensitivity 85.7%; Specificity 100% • Positive predictive value 100% (Gillen, 2011)
- Interphalangeal tenderness with ROM. Predictive value of 72.7% (Tepperman et al, 1984)

## People with CRPS also exhibit...

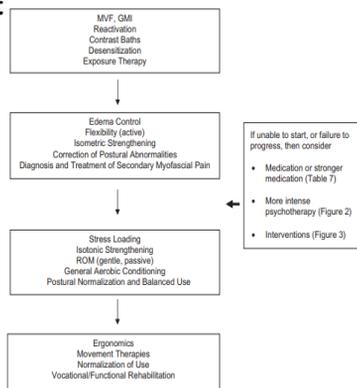
- Bone degeneration using dexta or CT scans (Kozin, 1977; Schweitzer, 1995)
- Skin thickening, soft tissue edema using MRI (Schweitzer, 1995)
- Cortical reorganization:
  - the sensory representation of the CRPS affected limb shrinks and shifts, and the degree of this alteration corresponds to the patient's pain intensity. Pain reduction is associated with normalization
  - Changes on the motor cortical representation associated with nonuse.

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## CRPS Treatment

- Preventative ROM exercises (see lesson)
- Clinical Treatment Guidelines: [Complex Regional Pain Syndrome: Clinical Treatment Guidelines | RSDSA](#)

**MVF** = mirror visual feedback;  
**GMI** = graded motor imagery



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### Non-Pharmacological Treatments

- Mirror Therapy – Level 1a evidence for improved motor function, pain, and ADLs
  - patient can “re-wire” the somatosensory cortex and its pertinent connections to correct the malfunction of the nervous system.
- Mental practice: - Level 1a for reduced pain
  - promotes neuroplastic changes without causing the affected individual any discomfort through movement
- Aerobic exercise: - Level 1b for reduced pain
- Other PT/OT:
  - desensitization (rubbing the affected limb gently with cloth)
  - gradual weight bearing
  - stretching and functional and fine motor exercises
  - activity tolerance training d/t disuse/nonuse

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Hemiplegic Shoulder Pain

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### Hemiplegic shoulder pain

- Frequency: 9% - 72% of post stroke hemi shoulder pain
- reduces participation in the rehabilitation process, leads to poorer recovery of arm function, lowers rates of discharge home and leads to increased length of hospital stay
- Most frequent causes: glenohumeral subluxation, and spasticity, particularly of the subscapularis and pectoralis muscles.
- You're more likely to get hemi-shoulder pain post-stroke if:
  - age greater than 70
  - poor arm motor function
  - supraspinatus tendon tear/tendinosis
  - biceps tendon effusion;
  - adhesive capsulitis

(Kim et al. 2014; Karaahmet et al. 2014; Wiener, 2018)

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“Medical”  
Interventions

- Botulinum Toxin Injections
  - Corticosteroids Injections
  - Hyaluronic Acid Injections (mimics the viscous synovial fluid)
  - Suprascapular Nerve Block
  - Oral Pain Medication
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- Evidence: Mixed Results
  - Only affects the symptoms of pain
  - Short Term Results

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## Pain With Subluxation? Subluxation With Pain?

WHEN DOES THIS TYPE PAIN OCCUR?

- Typical onset: 2-3 months post stroke (Poduri, 1993, as cited in Wiener, 2018).
- WHY? Fibrous changes or injury can occur in connective tissue of the ligaments and joint capsule due to incorrect alignment between the humerus and the scapula
- Increases over time within one year post stroke (Hansen et al., 2012; Langhorne et al., 2000; Ratnasabapathy et al., 2003, Sackley et al., 2008)

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### BUT:

- “Patients with shoulder subluxation may not have hemi shoulder pain and patients with hemi shoulder pain may not have shoulder subluxation” (Wiener, 2018).
- The lack of consistency among findings may be related to the heterogeneity of patient characteristics and method/timing of assessment (Paci, et al., 2005).
- Size of subluxation does not relate to the amount of pain (Bohannon & Andrews, 1990).

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**Most Cases Exhibit:**

- Changes in the mechanical integrity of the glenohumeral joint that results in incomplete dislocation
- Compression within the joint, impingement syndrome, subluxations
- Muscle/ Soft Tissue problems
- Muscle imbalance, decreased scapular movement, tendonitis, muscle tears

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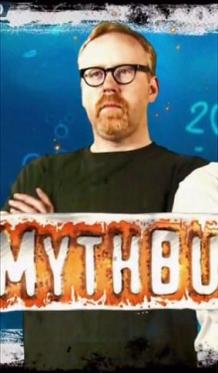
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**SLINGS!**

- Immobilization increases the risk of other pain syndromes including adhesive capsulitis and joint contracture and should be avoided (Dohle, 2013).
- May encourage flexor synergies, inhibit arm swing, contributing to contracture formation.
- Slings are likely not beneficial for shoulder hemiplegia following stroke. (Ada et al., 2016; van Bladel et al., 2017)



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Thank-you!

Steve Page, OTR/L, PhD, MS, MOT

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