

Post- Non-Haemorrhagic Stroke Hypersensitivity - A Case Report and Brief Review

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Abstract

It is well documented that stroke patients seeking care in critical period recover almost fully from their paresis/paralysis, but minimal awareness is there about experiencing reduced and/or altered sensation because of stroke. After a stroke your sensation can be affected. The pathways from the brain to areas of the body are complicated and sensory problems are different for everyone. Sensory deficits include reduced or exacerbated ability to feel touch, pain, temperature, position, or the ability to recognise objects one is holding. Some people experience feelings such as tingling, prickling, numbness, aching, burning or 'pins and needles. With altered sensation, movements may lack precision and control or even blow of air (direct or Coolers or Air conditioners) may appear painful.

Sensory re-education may have to be used to retrain or stimulate sensory pathways, through touching different textured objects, massage, vibration, pressure, determining joint position, identifying different temperatures. Sensory re-education can start from day one post stroke. Commonly recommended first- and second lines of pharmacotherapies like antidepressants, anticonvulsants, opioid analgesics, and lamotrigine, are more effective than others. Nonpharmacological interventions, such as transcranial magnetic or direct current brain stimulations, vestibular caloric stimulation, epidural motor cortex stimulation, and deep brain stimulation, are recommended in the management of therapy-resistant PS-TP. Interestingly, the stimulation to other areas, e.g., the motor cortex, periventricular / periaqueductal grey matter, and thalamus/internal capsule, show more effect than the stimulation to the thalamus alone. This article is based on Post stroke hypersensitivity case being managed currently and review of available literature and management practices.

Material & Methods: This article is based on case study a 51-year male software engineer, diabetic and hypertensive, having stroke in Mid-September 2023, who started getting sensory shock with fine touch of filaments of cloths since Mid-October 2023. He had non-Haemorrhagic infarct in the Right Thalamus, Right Parietal, temporal and Occipital lobes. Currently he is managing with exercises, relaxation methods like Meditation. Therapy with tapering cortisone has been suggested but not yet started.

Key Words: non-haemorrhagic stroke; central poststroke pain; thalamic pain; central pain; post-stroke thalamic pain; cerebral ischemia; right thalamus; right parietal; right temporal and occipital lobes infarct; neuroprotection; central nervous system agents; inflammation, transcranial magnetic or direct current brain stimulations, vestibular caloric stimulation, epidural motor cortex stimulation, deep brain stimulation.

Introduction

It is well documented that stroke patients seeking care in critical period recover almost fully from their motor functions like paresis/paralysis (Hemiplegia or Paraplegia), but minimal awareness is there about experiencing reduced and/or altered sensation because of stroke. Up to 80% of people who have a stroke experience sensory loss in their affected arm. This sensory loss puts the arm at risk for injury and impacts functional use of the arm and the survivors' level of independence during daily activities. Central imbalance, central disinhibition, central sensitization, other thalamic adaptative changes, and local inflammatory responses have been considered as its possible pathogenesis. There are very few studies and reports about recovery from sensory loss or

hypersensitivity. Multiple interventions for upper limb sensory impairment after stroke are described but there is insufficient evidence to support or refute their effectiveness in improving sensory impairment, upper limb function, or participants' functional status & participation. Poststroke thalamic pain a type of central poststroke pain, has been a hurdle to improve the rehabilitation outcomes and quality of life after a stroke. Its prevalence has been reported in 10–25% of stroke survivors. Most of the patient's failed to manage the pain and hypersensitivity effectively [4]. Despite the different pharmacotherapies and invasive interventions, the understanding about the effects of such interventions

used to address such impairments is limited and there is a need for more well-designed, better reported studies of sensory rehabilitation. [1,4].

A stroke occurs when blood flow in the brain is obstructed and brain cells are deprived of oxygen-rich blood, they begin to die and lose function. When brain cells are damaged after a stroke, that area of the brain has difficulty directing nerves and cells that control motor functions. A stroke damages the way the nerves control our muscles, leading to muscles contracting for long periods or going into spasm, which will be painful. As stroke occurs due to reduced perfusion to a brain region, resulting in death or temporary or permanent neurological deficits including hemiplegia, hemiparesis, numbness, loss of sensory and vibratory sensation, balance problems, ptosis, decreased reflexes, visual field defects, apraxia, and aphasia [2]. More than half of stroke survivors suffer from sensory impairments of their affected upper limb (UL), which are characterized by reduced sense of touch, temperature, proprioception, and pain [1,2, 3]. They tend to have trouble processing sensory receptors, leading to numbness in the limbs in people who have had a stroke. Since every stroke is different, everyone recovers at different rates.

While the Numbness, tingling starts from the tips of the fingers and toes, giving a feeling of slits, between fingers and toes, itchy, uncomfortable stinging and later spreading to the arms and legs. Numbness after a stroke is different from other types of anaesthesia because the problems originate in the brain, not the local tissues.

Every stroke is different, everyone recovers at different rates. While the motor deficit's recovery is assessed using Brannstrom's seven stages of stroke recovery, which are i) flaccidity, ii) spasticity appears, iii) spasticity increases, iv) spasticity decreases, v) complex movement combinations, vi) spasticity disappears, and vii) normal function returns. The best progress is indicated by becoming more Independent, can cross Legs, sleep more, find the need to compensate less with technique and Spastic Muscles are twitching [3].

Sensory loss (Numbness) recovery is done using Fugl-Meyer Assessment—upper extremity (FMA-UE) sensory section [5]. This measures light touch and proprioception of the UL after stroke. The score ranges from 0 to 4 points for each subtest with a maximum score of 8 points per hand. While the focus after stroke is often on recovery of neurologic function and reducing the risk of recurrence, the emergence of comorbid conditions like poststroke Central Post-Stroke Pain and chronic headache is often overlooked and undertreated. The overall prevalence suggests that approximately 14% of adult patients with ischemic stroke have headache at the time of or shortly following their stroke diagnosis.

Hypersensitivity after a stroke, is not a rare phenomenon, where after reduction in sensation (numbness) during the attack and first 3-4 weeks until the progresses get stabilized, sudden change may be observed and complained, when even a slight touch irritates or gives electrical stimulation to the patient along with the process of recovery of motor functions of the affected limbs. Studies have shown that mechanisms like apoptosis, necrosis, inflammation, immune modulation, and oxidative stress and mediators such as excitatory amino acids, nitric oxide, inflammatory mediators, neurotransmitters, reactive oxygen species, and withdrawal of trophic factors may lead to the development of the ischemic cascade of hypersensitivity. All these agents have been shown to improve neurological outcome after ischemic insult in experimental animals suggesting that these will aid in preventing long-term morbidity and mortality associated with ischemic stroke [1,2].

Biomarkers have recently begun to be used in clinical diagnosis of ischemic stroke, especially in the acute phase. It is still very difficult to identify specific biomarkers for a particular neuroreceptors, that trigger or affect pathological processes in ischemic stroke and the mechanism underlying each receptor's involvement in the disease's development is not yet fully understood. However, target-based drug design and discovery for treatment of ischemic stroke could be a good starting point to work on addressing hypersensitivity too!

Pain is common after stroke, with an estimated 30 to 40% of stroke patients experiencing some form of pain. If person is recovering from stroke and experiencing pain, it's important to first understand the underlying cause of the pain. Stroke patients can be encouraged to practice coping techniques at home also.

Case of Ravi who developed hypersensitivity after 4 weeks of Stroke:

Ravi, a 51-year male software engineer, started getting sensory shock even with fine touch of filaments of cloths in Mid-October 2023. He had a stroke on the morning of 16 September 2023 after short period of a Parieto- occipital headache since the morning of 15/09/2023. His main complaint apart from hypersensitivity is feeling of left Upper extremity heavy. On physical examination his sensory appreciation of fine touch and temperature was highly exaggerated especially when these happened without his knowledge or him seeing. He scored 15 points (maximum=25) in Monofilament & 18 points (maximum=36) in Shape and Texture test. Surprisingly firm holding of arm, pinching or pin prick did not bother him much.

History: A known hypertensive and diabetic over 15 years, measured BP at home which was 185/110, took some home Paracetamol tablet and rest. Next day too he had mild headache, therefore was resting most of the day. Around early morning of 16 September 0200AM midnight (16 & 17 September midnight) headache increased, and he found left sided hemiparesis, that made the family to take him to an emergency admission in private Hospital, in Yeshwanthpur Bengaluru.

On admission the general examination recorded a Pulse rate of 98/minute, BP-215/88. The patient was conscious, well oriented, with left sided parathesis and numbness with reduced sensation, ataxia, and muscular strength of 4/5. *Blood biomarkers down were* 1) Hb1Ac=8.1% 2) *Estimated average Blood sugar=186mg /DL,3) Total Cholesterol=179, 4) Triglycerides=190, 5) HDL Cholesterol=36 mg/DL, 6) LDL Cholesterol=127 mg/DL, 7) VLDL=38 mg/DL 8) Serum B 12 level=30pg/ml (as against 180-900 normal) 9) Plasma Homocysteine = 47.57mic.mol/L 10) Serum LFT biomarkers were all in normal limits. **Pulmonary function test showed mild restriction. An MRI brain showed right territory acute infarct. MRA showed right vertebral artery occlusion and an old right MC A-ACA watershed infarct.***

He was treated with dual antiplatelets, Statins and physiotherapy. At the time of discharge on 20/09/23 his BP was fully stables, left hemi-sided sensory loss with left sided ataxia. He was advised to take i) Ecosprin 150mg once in the afternoon) Clopilet 75 mg 1 tab in the afternoon iii) Rozat (Statin) tablet 20 mg in the night iv) Tab Homin (for treatment of deficiency of vitamin B6, B9, & B12) 1 at in the morning and night, v) Tab. Trivolib2 (combination of Glimepiride, Metformin and Voglibose) one tab in the morning, vi) Novomix 30 Flexpen 100IU/ml - 1mg, 12 units a day, vii) Tazloc 40mg (anti-hypertensive) in the morning.

Diagnosis:

- Non-Haemorrhagic infarct in the Right Thalamus, Right Parietal, temporal and Occipital lobes
- A chronic Infarct with gliotic areas and encephalomalacic changes in the Right Frontal lobe
- TOF Angiogram showed Stenosis of all the segments of Right Vertebral and Posterior Cerebral Artery

His involvement in ISCON's Bhajans (chanting Hare Krishan, Hare Krishan, Krishna Krishna Hare Hare, Hare Ram, Hare Ram, Ram Ram Hare Hare, and Meditation has helped him to cope with hypersensitivity in the last 2 weeks.

Discussions:

Stroke recovery takes a toll on mental health. Experiencing pain or hypersensitivity in recovery adds to stress level and increase sensitivity. More than half of stroke survivors suffer from sensory impairments of

their affected upper limb (UL) initially, which are characterized by reduced sense of touch, temperature, proprioception, and pain, but as the sensory recovery begins spontaneously on its own, sometimes with hypersensitivity within the first few months of recovery. Sensory impairments significantly limit the ability to use the upper limb after stroke. Like the loss of motor function in limbs (Hemi paresis) after a stroke, numbness occurs because the part of the brain that controls that limb has been damaged, and the brain works to compensate for the lost

signal, or even send mixed signals. People experience many different types of sensations during this process, depending on where and how much the stroke has occurred. Two brain regions that determine post-stroke numbness or hypersensitivity are: thalamus and occipital lobe. The thalamus is responsible for 98% of all sensory input and the occipital lobe distinguishes this input from the five senses, including touch. Therefore, post-stroke numbness is often seen after a hippocampal or occipital stroke because these brain regions play a large role in sensory function [6].

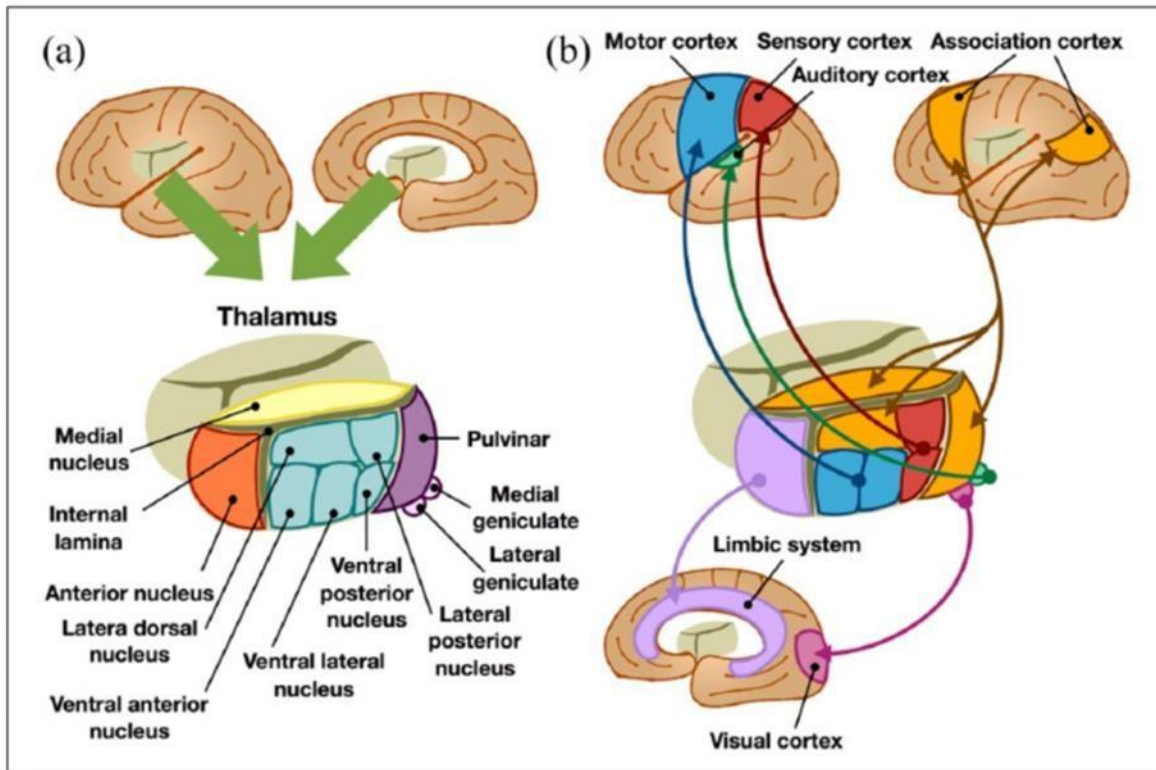


Figure: 1. (a) Anatomical and (b) functional classification of the thalamus

Source: The role of thalamus. Mult. Scler. J. 2019; 26:6–16.

There are four types of sensory deficits reported [3,4]:

- 1) **Shoulder subluxation & pain:** The shoulder joint separates, creating a gap between the humerus and the shoulder joint making the shoulder weak, a common condition after stroke. Common signs are decreased mobility, tingling & a sensation that the shoulder is out of alignment. Therapy consists of Strengthening the shoulder girdle muscles, by a range of motion exercises & proper positioning of the affected shoulder. A simple sling will improve stability & reduce pain.
- 2) **Central Post-Stroke Pain (CPSP):** CPSP is caused by damage to the central nervous system, which can lead to hypersensitivity. Our case of Ravi belongs this category. CPSP is often described by stroke survivors as a burning sensation or aching and shooting pains. An individual might jump at a light touch, even by the filaments of the spouses Saree. Patient experiences changes in skin temperature, skin colour and skin texture on the affected limb. They need to overcome hypersensitivity with sensory retraining. These are simple exercises that re-introduce patients to new and different textures. A therapist start testing with different thickness cotton, wool, silk filaments and then will gather objects with different textures and ask you to pick up the objects without looking at them to distinguish the difference among textures. Or a patient will be handed various objects with your eyes open and give

you time to sense how these objects feel. A Therapist always starts with something soft and smooth such as a pillowcase or sheet and work up to rougher textures such as a washcloth or jeans. If reassurance, meditation, and counselling does not help much Pain related to hypersensitivity is also commonly treated with a transcutaneous electrical nerve stimulation (TENS) device. This battery-operated unit can calm and soothe damaged nerves by delivering small electrical impulses through electrodes that have adhesive pads which are attached to the skin of the painful area. These devices are commonly used in hospitals but can be used at home.

- 3) **Headache:** Headaches are a confusing and misunderstood type of post-stroke pain. As the root of post-stroke headaches may be related to several causes but they are not a sign of a serious problem. Treatment includes medications & diet modification. Avoiding foods high in sugar and sodium and drinking plenty of water can improve headaches. Overweight, patients are encouraged to lose 10-15% of weight. A healthy diet plays an important role in reducing inflammation, sensitivity and makes feeling better overall.
- 4) **Spasticity:** Spasticity is another common post-stroke condition caused by an imbalance of signals from the central nervous system to the muscles. It occurs when a muscle involuntarily contracts when the patient moves and usually affects the elbow, wrist, and ankle. When a muscle can't complete its full range of

motion, the surrounding tendons and soft tissue can become tight, causing stiffness. This makes stretching the muscle much more difficult. In some cases, tightening of the muscles can become permanent leading to contractures. Gentle stretching exercises help calm a spastic extremity. Frustration while trying to complete a task, can worsen spasticity. By identifying triggers, one can work through them together and find other solutions to prevent worsening the condition.

Monitoring the Progress: Sensory recovery is assessed by following tests [2,6]:

Primary outcome measures:

1. Semmes-Weinstein monofilament: This is to assess touch detection thresholds of the hand and fingers. The short version with five filaments from 0.07 to 279 g are used. The touch detection thresholds are scored on a 0 to 5-point scale, where 5 represents the thinnest filament and 0 represents the largest filament. Five different positions of the hand are tested: the fingertip on digits I, II, and V and the thenar and hypothenar regions, yielding a total sum score of 25 points.
2. Shape/Texture Identification (STI™) test: This is to measure the ability to identify shapes (cube, cylinder, and hexagon) and textures (one, two, or three dots in a row) in decreasing sizes. The scores range from 0 to 3 points per hand for each subtest with a maximum score of 6 points. STI™ has been shown to have high test-retest reliability in persons with mild to moderate disability after stroke.
3. Fugl-Meyer Assessment upper extremity (FMA-UE; sensory section): This is to measure light touch and proprioception of the UL after stroke. The score ranges from 0 to 4 points for each subtest with a maximum score of 8 points per hand. It has been shown to be a clinically useful and a robust instrument in persons with sensory impairments after stroke.
4. Tactile object identification test: This is to measure the ability to identify different objects without vision. Out of 20 objects, 15 are used during the assessment. Within 15 s, the participant should blind folded recognize an object. A correct answer yields 2 points, recognition of some features of the object yields 1 point, and an incorrect answer yields 0 point, yielding a maximum total sum score of 30 points.

Secondary outcome measures:

1. Box and Block Test (BBT): This test assesses gross manual dexterity. It consists of a box with two compartments and of 100 wooden blocks. The number of blocks that can be transported from one compartment to the other during 1 min is counted. The BBT is reliable in persons with mild to moderate disability after stroke.
2. The mini Sollerman Hand Function Test (mSHFT): This test assesses fine manual dexterity. It consists of three selected tasks (1) picking up four coins from a purse, (2) putting four nuts on bolts, and (3) buttoning four buttons. The score ranges from 0 to 4 points for each task with a maximum score of 12 points. The mSHFT has been shown to be reliable in persons with mild to moderate disability after stroke.
3. Modified Motor Assessment Scale (M-MAS) of the UL: This assesses dexterity by five tasks in the advanced hand activity domain. The scale ranges from 0 to 5 points, where 0 represents no motor function and 5 represents almost normal or normal motor function. It has good reliability and validity after stroke.
4. Gripit: This test measures isometric grip strength using a computerized wireless dynamometer. has been shown to be reliable in persons with mild to moderate disability after stroke.

Treatment: Here are some treatments used for central neuropathy/central poststroke pain:

1. Sensory re-education: These are simple exercises that re-introduce patients to new and different textures. A therapist start testing with different thickness cotton, wool, silk filaments and then will gather objects with different textures and ask you to pick up the objects without looking at them to distinguish the difference among textures. Or a patient will be handed various objects with eyes open and give him/her time to sense how these objects feel and then test blindfold [1,2].
2. Relaxation Methods: Finding ways to relax and reduce stress is very important. Exercise and a healthy diet help but need to be complimented with other methods that can relax mood like listening to music, playing chess game, doing Bhajans or Japa's add to relaxation [2,6].
3. YOGA: Yoga is a good complement to physical therapy as it incorporates breathing exercises and helps relaxation, which can decrease pain [1,6].
4. Meditation: Incorporating meditation into daily routine, not only helps reduce blood pressure, but also manage insomnia, depression and anxiety and hypersensitivity. Simply start sitting quietly and focusing on breath and when the mind wanders, gently bring it back to breath, gradually increase the time to stay focused [2].
5. Medications: Antidepressants, Corticosteroids, Treatment of acute or subacute hypersensitivity is with corticosteroids, usually prednisone 60 mg orally once a day for 1 to 2 weeks, then tapered over the next 2 to 4 weeks to 20 mg once a day, followed by weekly decrements of 2.5 mg until the drug is stopped [3].
6. Other modern methods: Electroacupuncture, Deep-brain stimulation and Repetitive transcranial magnetic stimulation are some of the latest methods tried inpatients who do not respond to simple training [6].

Conclusion:

It is well documented that stroke patients seeking care in critical period recover almost fully from their motor functions like paresis/paralysis (Hemiplegia or Paraplegia).

There is minimal awareness about experiencing altered sensation because of stroke.

Multiple interventions for upper limb sensory impairment after stroke are described but there is insufficient evidence to support or refute their effectiveness in improving sensory impairment and upper limb function. Sensory re-education, relaxation methods often help. Medical treatment of acute or subacute hypersensitivity is dependent on oral corticosteroids therapy.

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