Variations on a Theme – Pure Sensory Strokes

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Abstract

Cerebrovascular accidents or strokes are one of the leading causes of death and disability in the United States and can present in a variety of ways depending on which part of the brain is impacted. The traditional presentation of a stroke involves motor deficits and speech impairment but in some instances, strokes may be purely sensory. Often these strokes are in the thalamus which serves as a relay center for motor, sensory, and limbic pathways. Due to the presence of multiple tracts and communication channels, an infarct in the thalamus can lead to different constellations of sensory symptoms. Two clinical conditions that fit this vignette are Cherio Oral Pedal Syndrome where a patient experiences numbness of the corner of the mouth, hand, and foot, and Thalamic Pain Syndrome where a patient has severe pain and altered sensation in ipsilateral areas of their body. Herein we present two patients presenting with the above symptoms as a result of suffering lacunar infarcts in the right thalamus visualized on MRI. One patient is an 86-year-old female with a medical history of essential tremor status post deep brain stimulator who presented with left-sided numbness in the corner of the mouth, over the hand, and in the foot for 12 hours. The other patient is a 47-year-old man with a medical history of obesity and atrial fibrillation who presented with left-sided numbness and pain which started 6 hours after the initial numbness in the same areas. In both cases aside from diminished or altered sensation, the patients had grossly normal physical exams. The lack of additional symptomatology and evidence of stroke only visible on MRI highlights the significance of utilizing neuroanatomy and somatosensory tracing to determine the origin of the infarct.

Introduction

Strokes are one of the leading causes of death for Americans and significantly contribute to the cost burden of healthcare services[18]. Stroke education is becoming more widespread and has been central to many health initiatives with recognition, intervention, and follow-up having a significant impact on morbidity and mortality[18]. However, not all strokes are created equal. Some involve the traditional symptoms recognized by the public of sudden numbness, change in vision, facial asymmetry, confusion, and change in speech, but others may have an atypical presentation dependent on where the stroke occurs[9,18]. A subset of strokes involves deeper structures of the brain and are categorized as lacunar strokes[1,3]. These have the possibility of presenting as purely sensory disturbances which may have delayed recognition leading to

delayed diagnosis and intervention[1,3,]. One structure commonly affected in lacunar strokes is the thalamus[1,3,5,19]. The thalamus is a paired structure of the diencephalon located near the center of the brain and serves as a relay center for motor, sensory, and limbic pathways[14]. If blood flow to the thalamus is disrupted any of these pathways can be affected. In certain instances where the nuclei of the thalamus that relay sensory signals are impacted, a patient may experience a purely sensory stroke[1,14]. They may present without typical findings of a stroke discussed above making their diagnosis difficult which can lead to misdiagnosis or delayed treatment of the patient.
Two clinical conditions that fit this vignette are Cherio Oral Pedal Syndrome where a patient experiences numbness of the corner of the mouth, hand, and foot, and Thalamic Pain Syndrome where a patient has severe pain and altered sensation following stroke[2,3,5,6,12,13]. It has been found that either syndrome may spontaneously resolve or improve but some patients will require lifelong management of symptoms[3,10]. Because of the rarity of these syndromes and their localization to only a few areas of the anatomy of the brain pathways, this serves as both a primer on the anatomy and a reminder of clinically relevant areas for the clinician to ensure that they are not missed during the review of the imaging with neuroradiology[15,16]. Altered sensation and perception can be devastating on their own, but not identifying that a patient had a stroke in the first place can be detrimental to their future health if proper preventative interventions are not put in place.

Case Presentation

COPS

History and Physical Exam

Our first patient is an 86-year-old woman with a medical history of essential tremor s/p deep brain stimulator, recurrent urinary tract infections, hypertension, hyperlipidemia, and asthma who presents to our comprehensive stroke center with a chief complaint of left-sided numbness in the corner of the mouth, over the hand, and in the foot for 12 hours. She states that she had noticed it the previous night, thought that the symptoms were odd, and made the executive decision to try to sleep it off, hoping it would go away. Upon awakening, the patient noted that she was struggling to move her foot in three-dimensional (3D) space and as a result was dragging her foot to stably walk to the bathroom. The patient endorsed that the numbness was only in the

hand, foot, and corner of her mouth, but denied weakness, numbness in other areas, joint pain, muscle pain, or visual changes.

When asked, the patient did note experiencing migraine headaches for the last 4 months, refractory to Tylenol and ketorolac, with intermittent nausea, and associated photophobia and phonophobia. However, in this particular instance, the patient stated that she was not currently experiencing her migraine symptomatology and denied having any previous history of auras. The patient denied any constitutional, cardiovascular, respiratory, gastrointestinal, genitourinary, or psychiatric symptoms.

On physical examination, blood pressure was elevated to 163/128 mmHg, respiratory rate was 10 breaths/min, and her oxygenation on room air was 94%. Other vitals were within normal limits. The patient was not in acute distress and was sitting up in the CT scanner answering questions appropriately. Cranial nerve V presented with diminished sensation around the corner of the left side of the mouth. The rest of the cranial nerve exam was normal. Bilateral strength and reflexes were normal. Sensation examination indicated numbness and paresthesia of the left V2 distribution, left C6-8 distribution and left S1-2 distribution. The patient had normal cerebellar function. A stroke alert was called and a patient assessment was completed. The patient's last known well time was 21:00 with a stroke alert called at 8:57 the next morning when she presented with complaints that the emergency room physician noted to likely be a stroke syndrome.

Differential Diagnosis

In this particular case, the differential for the cause of the patient's symptoms is fairly large with a number of the possibilities being directly related to causes of nerve damage. These include stroke, deep brain stimulator malfunction, brain tumor, cavernous hemangioma, iatrogenic injury, complicated migraine, transient ischemic attack, multiple sclerosis, vitamin b12 deficiency trigeminal nerve palsy, giant cell arteritis, peripheral nerve injury, spinal stenosis, and adverse effect of medication. However, the vast majority of these could be easily ruled out due to the patient's rapid onset of symptoms. Because of the risk factors of hypertension, history of migraine headaches, her deep brain stimulator, and hyperlipidemia, the specter of stroke rose in the differential.

Labs and Imaging

Due to the patient's symptoms and presentation, the stroke team was appropriately called. Per protocol, a CT head without contrast and a CT angiogram of the head and neck were performed and both were unremarkable. After verifying with Medtronic that the patient could safely undergo MRI, an MRI diffusion-weighted imaging (DWI) scan was performed. The MRI DWI indicated ischemic stroke localized to the right thalamus, likely due to small vessel disease. The significant MRI images are provided in Figure 1. The patient also had a transthoracic echocardiogram while in our care that revealed a 68% ejection fraction without evidence of intraarterial septal defect.

Diagnosis and Treatment

Based on the MRI imaging, the history, and the physical examination, the patient was diagnosed with a small vessel stroke likely secondary to her deep brain stimulator due to the stroke's conspicuous location. Her symptomatology fits the classical cheiro-oral-pedal syndrome secondary to a lacunar infarct localized to the right thalamus on a DWI MRI of the brain. Due to the timeframe in which she presented, approximately 12 hours after the onset of symptoms, tPA was not a treatment option[6,8,9].

Per stroke protocol, she was started on 40 mg atorvastatin and 81 mg aspirin[9]. Due to her 4-month history of migraine headaches, the stroke team began a trial of 40 mg propranolol for prophylaxis of future headaches. She was monitored during the stroke workup in order to act quickly if she were to have another stroke and set up with close follow-up for a workup of her migraine headaches. Because of the location of the stroke and its presentation, the patient was given further instructions on the need to return for any neurological symptoms and discharged to home.

THALAMIC PAIN

History and Physical Exam

Our second patient is a 47-year-old man with a history of obesity, type 2 diabetes mellitus, hypertension, obstructive sleep apnea, and paroxysmal atrial fibrillation reportedly non-adherent with rivaroxaban who presented with left-sided numbness and pain which started 6 hours after initial numbness in the same areas. At the bedside, the patient reported left-sided symptoms described as shooting pain in the left forehead, left maxilla, left neck, from midline chest to left

axilla, and in the left thigh. He described the numbness as "feeling as if the areas are swollen" and "weird."

He reported an associated severe, stabbing pain headache, present bilaterally behind his eyes. He denied any associated weakness, nausea, vomiting, blurry vision, photophobia, or phonophobia. He noted no symptoms on the right. His headache was present for an hour before resolving and then returning. He denied any fevers, chills, diarrhea, or dysuria. During the examination, the patient was fully alert and oriented with normal affect and no acute distress. He was speaking in full, coherent sentences with intact repetition, fluency, and comprehension. Cranial nerve testing revealed diminished facial sensation to light touch in the left forehead, left cheek, and left neck but intact in the posterior and temporal head. The remainder of cranial nerve testing was normal. He had diminished sensation to light touch in the left forehead, left cheek, left neck, left chest (from the midline to left axilla), and left thigh in the anterior but not posterior region, otherwise intact sensation in arm and legs throughout. Coordination was intact and the remainder of the physical exam was unremarkable.

The patient states his atrial fibrillation was diagnosed in April 2023 and he was prescribed rivaroxaban, but he did not follow up with cardiology or take medication regularly due to his busy work schedule. He also endorsed a history of a “grand mal” seizure in childhood and again in his 20s for which he was briefly on phenytoin. He underwent an EEG but was told he did not have epilepsy and phenytoin was discontinued.

Differential Diagnosis

Due to patient presentation and symptom complaints, the differential diagnosis includes but is not limited to stroke, transient ischemic attack, multiple sclerosis, brain abscess, peripheral neuropathy, and trigeminal nerve palsy with the most likely diagnosis being stroke leading to central pain syndrome or thalamic pain syndrome.

Labs and Imaging

A computerized tomography (CT) head and Computerized Tomography Angiogram (CTA) of the head and neck were obtained which were negative for vessel stenosis. A magnetic resonance image (MRI) of the brain was then performed which revealed an acute punctate lacunar infarct in the right thalamus as well as microvascular ischemic white matter disease and tiny remote lacunar infarct in the left basal ganglia. This can be seen in Figure 2. The patient’s hemoglobin A1C was elevated at 6.1% and his LDL was elevated at 71 mg. His other labs were within

normal limits. Because of the likely etiology of the stroke, medium vessel disease versus atrial fibrillation, he underwent testing for an acute thrombus in the heart.

Diagnosis and Treatment

The patient was diagnosed with a thalamic stroke and secondary thalamic pain syndrome. He was started on standard dose rivaroxaban, atorvastatin 40 mg, and aspirin 81 mg daily to prevent further strokes[9]. This method was chosen secondary to SAMPRIS data recommending DAPT, with the caveat that his atrial fibrillation would have necessitated triple therapy so double therapy instead was utilized. For pain management, 100 mg gabapentin three times a day was utilized to provide relief with increased doses being available as necessary based on symptomatology[11]. Three months after his stroke, the patient reported complete amelioration of the pain, with the caveat of interspersed episodes of recurrence of symptoms. Education on recrudescent was provided at that time.

Discussion

These patient cases highlight several key concepts. First, Cheiro-oral-pedal syndrome (COPS) and Thalamic Pain Syndrome are largely clinical diagnoses that are supported by imaging studies raising the specter of stroke within the differential[3,4,16,19]. The leading causes of COPS and Thalamic Pain Syndrome include stroke or hemorrhage in the midbrain, pons, thalamus, or medulla[3,4,16,19]. The key to localizing lesions in these syndromes is similar to any other neurological pathology – know neuroanatomy. The sooner a lesion is localized and identified utilizing neuroanatomy knowledge and advanced imaging, the sooner the treatment can begin. In these cases, the duration of their symptoms put them outside the optimal window to use tissue plasminogen activator (tPA) which is indicated within 4.5 hours of the patient's last known well time, however, neuroanatomy remains key in the diagnosis[8,9]. A definitive diagnosis can indicate additional treatment options to diminish the chances of future complications.

What these patients have in common is the area of their thalamic infarct. The thalamus is situated in a way where various nuclei are clustered together characterized by cohesive function[14]. The area of interest in these patients is the ventral posterior nucleus. Sensory information from a patient's environment is transmitted along the spinothalamic tract and dorsal column depending on the type of stimulus[14]. These signals then decussate in the thalamus in the ventral posterolateral nucleus (VPL)[14]. These tracts carry sensory information from the upper and lower

extremities which run adjacent to each other in the cuneate fasciculus and gracile funiculus[14]. Adjacent to this is the ventral posteromedial nucleus (VPM) where the signals from the second-order neuron of the trigeminothalamic tract are transmitted[14]. Therefore, a lesion resulting in paresthesias of the corner of the mouth and ipsilateral hand and foot without motor impairment is likely located around the VPM and VPL of the thalamus. Similarly, a lesion resulting in altered sensation of the forehead, maxilla, neck, chest, axilla, and thigh without motor impairment is likely located around the VPL. In this case, specifically, the ability to correctly interpret tactile information was adversely affected leading to the patient experiencing shooting pain, numbness, and a feeling of swelling. An interesting difference between the two cases is that the COPS patient had non-painful paresthesia while the Thalamic Pain patient had an altered perception of tactile stimuli leading to pain sensations. This difference is most likely due to the pinpoint location of the infarct in relation to the somatosensory pathways – efferent versus afferent. While neither patient presented with typical stroke symptoms, they were recognized as likely stroke patients and underwent appropriate workups due to astute clinical recognition. The differential remained broad due to the purely sensory symptoms and included stroke, brain tumor, cavernous hemangioma, iatrogenic injury, complicated migraine, transient ischemic attack, multiple sclerosis, vitamin b12 deficiency, trigeminal nerve palsy, giant cell arteritis, peripheral nerve injury, spinal stenosis, and adverse effect of medication. Through appropriate workup the differential was narrowed to pure sensory stroke due to lack of other symptoms, largely normal test results and vitals, and later imaging which confirmed the location. The thalamic infarcts were unable to be visualized on CT and instead required MRI which necessitated interpretation by a neuroradiologist for appropriate localization[15]. It should also be noted that the cause of stroke in the COPS patient was suspected to be small vessel disease related to the presence of her deep brain stimulator, a known complication[7,13]. Conversely, it was suspected the cause of stroke in the Thalamic Pain patient was medium vessel disease associated with his history of atrial fibrillation.

Once appropriately diagnosed, the patients were treated based on their presentations despite having lesions in similar locations. The COPS patient was treated with migraine prophylaxis, atorvastatin, and aspirin to decrease the risk of future stroke. The Thalamic Pain patient was treated similarly with atorvastatin and aspirin but also required rivaroxaban due to his atrial

fibrillation and gabapentin due to his altered pain perception. The COPS patient had purely paresthesias so did not require pain modulation medication.

An alternative treatment option for both patients when assessed from an osteopathic perspective could include cranial and somatic osteopathic manipulative treatment (OMT)[17]. As discussed above, the thalamus is a relay center for motor, sensory, and limbic pathways[14]. For these reasons, it was determined that the thalamus can modulate pain through its processing of nociceptive information before transmission to the cortex[4]. It could then be possible to influence thalamic function through cranial OMT, including compression of the fourth ventricle, lifts, suture spread, membranous balance, and decompression, which has been shown to affect interoceptive networks and functional brain connectivity[17]. It has also been shown that cranial OMT influences cerebral perfusion which could be considered once a patient is deemed stable[17]. It is possible since the patients experienced ischemic strokes prior to symptom onset that later in rehabilitation if the cerebral perfusion is addressed, the symptoms could be positively impacted. In addition, it has been proven that changes in autonomic function can manifest somatically which would likely be present in patients experiencing sensation deficits[10]. Therefore, treating a patient somatically to dampen the sympathetic response may also yield a positive outcome[10].

Conclusion

These patient cases highlight the importance of symptom recognition and neurologic lesion localization. Pure sensory strokes are not common, but when the lesions are examined critically the symptomatology makes sense; the somatosensory system decussation and relay patterns just need to be traced. COPS and Thalamic Pain Syndrome are rare diagnoses but can be identified clinically based on their characteristic patterns of altered sensation through this method. Early clinical identification gives rise to early intervention which positively impacts clinical outcomes. If appropriate, OMT techniques, such as cranial, can be used as an adjunct therapy to influence cerebral perfusion and interoceptive networks.

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Graphic Elements

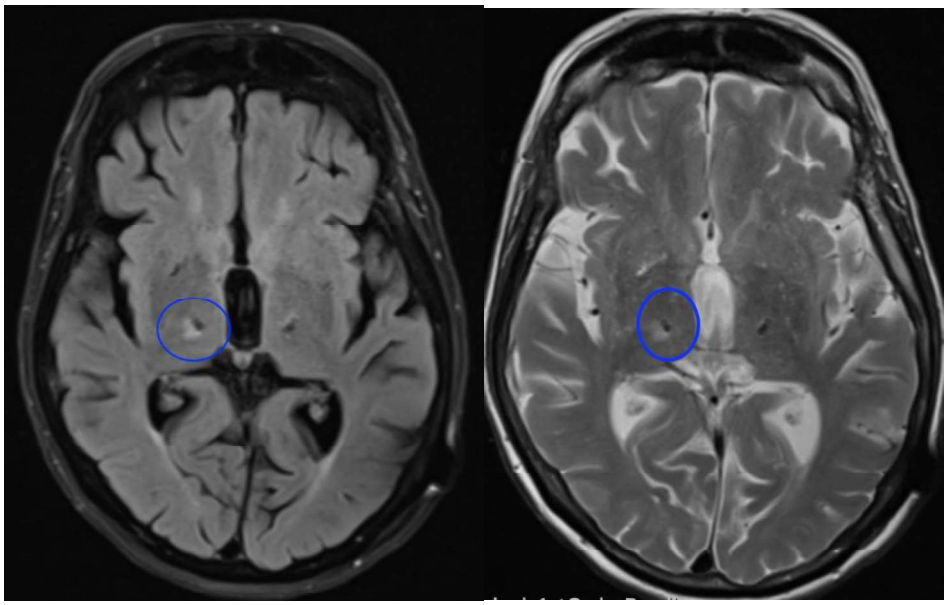

Figure 1. T2 Flair and ADC Imaging of the lesion located in the right-sided thalamus in patient presenting with COPS

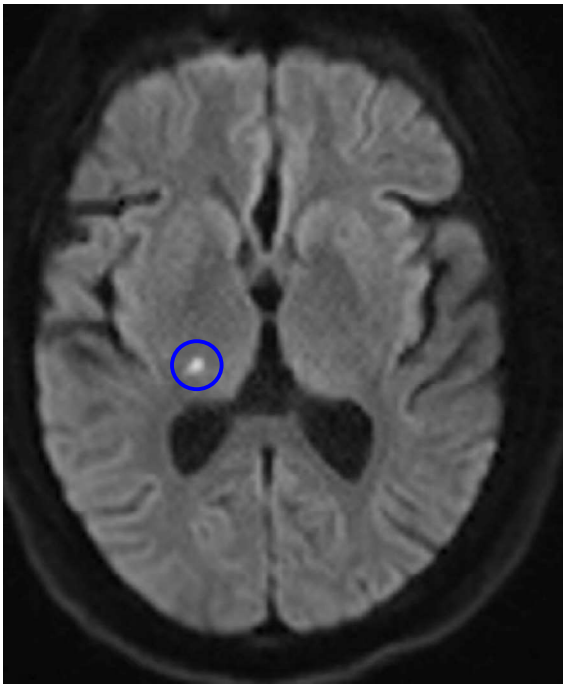

Figure 2. T2 DWI MRI Thalamic Lesion that led to Thalamic Pain Syndrome

Conflict of Interest:

Whitley Figge: Whitley Figge declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Thomas C. Varkey: Thomas Varkey declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Luke Kloft: Luke Kloft declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Tamim Sultani: Tamim Sultani declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Andrei Alexandrov: Andrei Alexandrov declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.