CLINICAL VIGNETTE

Wallenberg Syndrome

Roger M. Lee, MD, Spencer R. Adams, MD, Doojin Kim, M.D.

Wallenberg syndrome, also called lateral medullary syndrome, results from an acute infarct that involves the lateral region of medulla oblongata. The clinical signs and symptoms can be variable depending on the size of the stroke and the affected nerve tracts. The syndrome is usually readily identifiable as it frequently causes a characteristic set of neurological deficits that includes sensory deficits affecting the ipsilateral face and the contralateral trunk and extremities. The syndrome is caused by a variety of diseases that lead to occlusion of the vertebral artery or the posterior inferior cerebellar artery (PICA). Treatment is mainly supportive. We present a case of a young woman with Wallenberg syndrome after a vertebral artery dissection.

Case Report

A 36-year-old woman was working toward her scuba diving certification four weeks prior to admission. As part of the certification, she performed vigorous repetitive cervical flexion and extension maneuvers to learn how to clear water from her scuba mask. She subsequently complained of a "migraine headache" that resolved after several days. She also complained of neck pain that persisted for several weeks. Due to ongoing neck pain, she presented to the emergency room (ER) where she was felt to have a cervical strain and she was treated with intravenous ketorolac and oral diazepam. A week later, she traveled to Mexico for a scuba diving trip without significant problems. Upon her return home, she started feeling intermittent 'dizziness' as well as a 'pulling sensation' to the left (lateropulsion) during ambulation. She also complained of changes in her taste sensation. Her lateropulsion became progressively worse. In addition, she developed diplopia and numbness and decreased temperature sensation of the left face and right trunk and extremities. With this array of new symptoms, the patient returned to the ER for evaluation.

The patient's past medical history was significant only for migraine headache and seasonal allergies and current medications were cetirizine and birth control pills. She worked as a pilates instructor and did not smoke or use any recreational drugs. She drank alcohol occasionally. There was no family history of thromboembolism, miscarriages, cardiovascular problems, or connective tissue disorders. Initial physical examination showed normal vital signs except for blood pressure of 138/99 mm Hg. Cardiopulmonary exam was normal. There were no carotid bruits. Neurological examination was notable for normal speech and orientation. Anisocoria was identified with right pupil measuring 5 mm and left pupil measured 3 mm. There was slight ptosis of the left eye consistent with Horner's syndrome. Motor strength was normal throughout. Light touch and temperature sensation were decreased on the left face and right trunk and extremities. The patient had abnormal gait with significant ataxia and leaning toward the left.

Laboratory evaluation showed normal blood count and basic metabolic panel except for sodium of 127 mmol/L (normal range 135-145). Serum osmolality, urine osmolality, and urine sodium were 258 mosm/kg (range 275-295), 704 mosm/kg, and 214 mmol/L, respectively. CT scan of the brain was normal. Initial MRI of the brain showed a subtle infarct in the left lateral medulla (Figure 1). MRI of the neck showed evidence of a right internal carotid artery dissection and decreased flow of the left vertebral artery. Subsequent CT angiogram of the brain and neck confirmed a right internal carotid artery and left vertebral artery dissections (Figure 2).

The patient was diagnosed with Wallenberg Syndrome, left lateral medullary syndrome and hyponatremia due to the syndrome of inappropriate antidiuretic hormone (SIADH). A heparin drip was started immediately because of the dissections. Repeat MRI of the brain the following day showed definite infarction at the left lateral medulla. Transesophageal echocardiogram did not reveal cardiac thrombus. A hypercoagulable laboratory workup and alpha-1

antitrypsin antibody were normal. The patient was transitioned to warfarin for long-term anticoagulation and was discharged home with home physical and occupational therapy.
On follow up three months later, the patient's ataxic gait and diplopia had resolved, but the Horner's syndrome and decreased light touch and temperature sensations of her left face and right trunk and extremities persisted. Repeat MRI of the brain showed an old left lateral medullary infarction (Figure 3). MRA of the neck showed decreased lumen caliber of right distal internal carotid artery compared to the left and no flow to left vertebral artery (Figure 4).

Discussion

Gaspard Vieusseux of Geneva first described lateral medullary syndrome in 1810 at the Medical and Chirurgical Society of London[1]:

"Vertigo, unilateral facial numbness, loss of pain and temperature appreciation in the opposite limbs, dysphasia [sic] and hoarseness, minor tongue involvement, hiccups (cured by taking up the habit of a morning cigarette) and a drooped eyelid."

Subsequently, Adolf Wallenberg published the first case report in 1895 detailing the clinical syndrome and in 1901 his second case report with a postmortem description of the lateral medullary infarction from a stenosis at the origin of PICA. By 1922, he described 15 patients with this syndrome[1]. Lateral medullary syndrome thus became synonymous with 'Wallenberg syndrome'.

Anatomically, the lateral region of the medulla oblongata is flanked anteriorly by anterior lateral sulcus and posteriorly by posterior lateral sulcus. Rostrally, it is bordered by the pons and caudally by the cervical spinal cord. This area contains multiple nerve nuclei and tracks. These include the inferior cerebellar peduncle, vestibular nuclei, spinal trigeminal nucleus, descending sympathetic fibers, dorsal motor nucleus of the vagus nerve, lateral spinothalamic tract, nucleus ambiguus, solitary nucleus, medullary reticular formation, and central tegmental tract. Because of the tight packaging of nerve nuclei and tracts in the lateral medulla, clinical signs and symptoms of Wallenberg syndrome can incorporate dysfunctions in the vestibulocerebellar, sensory, bulbar, respiratory, and autonomic systems.

Vestibulocerebellar functions are controlled by the vestibular nucleus and inferior cerebellar peduncle. Injury to these nerves can give a patient a sense of dizziness and imbalance with a pulling or falling sensation (lateropulsion) ipsilateral to the lesion. Often, a patient is not able to ambulate without assistance and not able to sit straight without support. In addition, blurry vision, diplopia, oscillopsia, or horizontal and rotational nystagmus can occur. Injury to spinal trigeminal nucleus and/or tract creates ipsilateral decrease in facial pain and temperature sensation, whereas damage to lateral spinothalamic tract causes decreased temperature sensation and pain to the contralateral trunk and extremities. The nucleus ambiguus is located more medially in the lateral medullary region and is responsible for vocal cord and palatal muscles function. When this nucleus is injured, patients demonstrate symptoms of dysphagia, hoarseness, and diminished gag reflex ipsilaterally. Damage to descending sympathetic fibers will create ipsilateral Horner's syndrome with classical signs that include miosis, ptosis, and anhidrosis. The solitary nucleus is involved in taste function and patients often complain of decreased taste sensation when damage occurs to this nucleus. The dorsal motor nucleus of the vagus nerve is involved with autonomic nervous system and patients can present with signs and symptoms of tachycardia, orthostatic hypotension without tachycardia and intermittent bradycardia. Injury to the ventrolateral medullary tegmentum and medullary reticular zone can interfere with respiratory function with failure of automatic respiration or also known as Ondine's curse where patients experience respiratory arrest during sleep[1-5].

Some nerve tracts are more frequently involved. Many case series have been published describing the signs and symptoms of Wallenberg syndrome[4, 5, 7]. In a study of 130 consecutive patients, Kim demonstrated that patients commonly present with sensory deficits, gait ataxia, dizziness, and Horner's syndrome. The next most common signs and symptoms include dysphagia, hoarseness, vertigo, nystagmus, limb ataxia, nausea/vomiting, and headache. Less commonly, patients will have skew deviation, diplopia, dysarthria, facial paresis, and gaze deviation[4]. With the clinical signs and symptoms of our patient, it is likely that she had injury to at least to the descending sympathetic fibers, inferior cerebellar peduncle, spinal

trigeminal nucleus/tract, lateral spinothalamic tract, and solitary nucleus.

The blood supply to medulla oblongata includes the anterior spinal artery, vertebral artery and posterior inferior cerebellar artery (PICA). The anterior spinal artery supplies the medial aspect of medulla. Whereas, the PICA supplies the posterolateral region and the vertebral artery supplies the area between the anterior spinal artery and PICA[6]. Occlusion from any cause of the vertebral artery or PICA can result in lateral medullary infarction and Wallenberg syndrome. In his original publication, Wallenberg attributed the infarction to disease in the PICA. However, in subsequent studies, compromised blood flow to the vertebral artery account for the majority of cases. Angiograms showed 64-73% of the patients with Wallenberg syndrome had vertebral artery disease and only 9-14% had disease in PICA[4,5,7,8].

A variety of causes can interrupt blood flow to the vertebral artery and PICA. These include atherosclerotic disease, thromboembolism, infection, space occupying lesions such as a tumor or hematoma, congenital atresia of the vertebral artery, or vertebral artery dissection[4, 9-11]. Atherosclerotic disease is the most common cause. Vertebral artery dissection is responsible for about 15% of cases and occurs mainly in young patients[5]. This is important to remember as vertebral artery dissection causes about 2% of strokes in the general population, but accounts for approximately 20% of strokes in patients younger than 45 years old.[9]

The vertebral artery is divided into four segments. Tortuous third segment where the artery exits the transverse foramen at C2 vertebra, makes a 90^{o} turn, and lies along C1 vertebra before it enters the dura posterior medially is most prone to injuries from various activities[9, 12, 13]. Intrinsic factors such as diseases leading to collagen defects (eg. Ehlers-Danlos syndrome, etc) put patients at increased risk of having vertebral dissection[2, 14, 15]. Extrinsic factors include major trauma to the neck like motor vehicle accidents, blunt trauma, and strangulation. Minor trauma such as coughing, prolonged ceiling painting, archery, yoga, sneezing, lifting weights, falls, and scuba diving are also reported in patients with vertebral artery dissection. Chiropractic manipulation of the neck has also been linked to vertebral artery dissection[2, 9, 14-17].

Studies have concluded that the risk of injury and compromised blood flow with mechanical distortion to the distal third segment of vertebral artery is more likely with activities that include cervical rotation, sustained end-of-range cervical spine rotation, and full range, sustained cervical spine rotation. These activities should be avoided in clinical practice[13]. Our patient performed vigorous flexion and extension of her neck with possible rotational movement in her scuba diving training, which likely contributed to her vertebral artery dissection.

Symptoms associated with vertebral artery dissection are variable. Some patients can be asymptomatic. However, others can have initial symptoms of headache and persistent neck pain[10, 18, 19]. The dissection may heal without additional sequelae. Other patients may develop neurologic deficits with or without additional injury to the vertebral artery[19]. Our patient may have suffered additional trauma to her vertebral artery and additional dissection during her scuba diving trip one week prior to admission.

Treatment for Wallenberg syndrome is directed toward the underlying cause and is similar to other acute cerebral vascular accidents. Neurology consultation is recommended for assistance in management. In patients with vertebral artery dissection, treatment is often with antithrombotics. Traditionally, anticoagulation has been used to prevent recurrent thromboembolism and to aid in healing. Recently, treatment has been moved away from anticoagulation towards antiplatelet therapy. Thrombolysis of the dissecting artery is not usually performed because of the risk of extension of vessel wall hematoma, dislocation of intraluminal thrombus, subarachnoid hemorrhrage, and pseudoaneurysm formation. If anticoagulation is employed, treatment is with vitamin K antagonists (warfarin) for 3 to 6 months with the goal of international normalized ratio between 2.0-3.0. Antiplatelet therapy with aspirin and/or clopidegrol can also be considered. Lastly, surgical intervention can be considered if the patient has contraindications to anticoagulation, failed anticoagulation treatment with recurrent symptoms, expanding or symptomatic pseudoaneurysm, or significantly compromised cerebral blood flow.[2]

Recovery from Wallenberg syndrome is generally good. The majority of patients

experience partial if not complete recovery of neurological deficits. In a study of 18 consecutive patients with lateral medullary infarction, eighty-five percent were ambulating independently after a year of follow up. Five out of seven patients who previously worked were able to return to their work. The majority of the patients were able to resume their previous activities[20].

In conclusion, lateral medullary syndrome, also known as Wallenberg syndrome, results from infarction of the lateral region of medulla oblongata. Numerous nuclei and nerve tracks are located in the region. Clinical signs and symptoms can be variable depending on which tracks are injured, but most patients will have ataxia, sensory deficits, dizziness, and Horner's syndrome. Diseases in the vertebral artery and posterior inferior cerebellar artery are the typical etiology of the syndrome. Vertebral artery dissection is a more common cause in patients younger than age 45 and is frequently caused by minor neck trauma from rotational activities. Treatment depends on the underlying cause and includes anticoagulation or antiplatelets for vertebral artery dissection. Clinical recovery of Wallenberg syndrome is generally good with most of the patients regaining the prior functional activity.

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FIGURE LEGENDS:

Figure 1: Acute infarct in the left lateral medulla on DWI MRI.

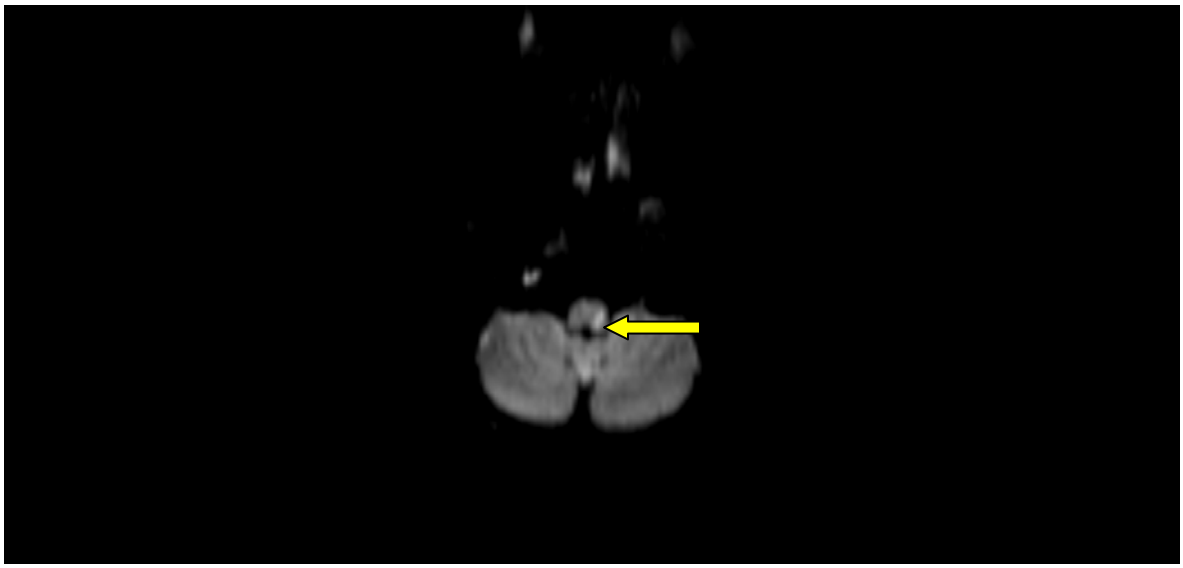


Figure 2: Attenuation of flow in left vertebral artery seen on CT Angiogram.

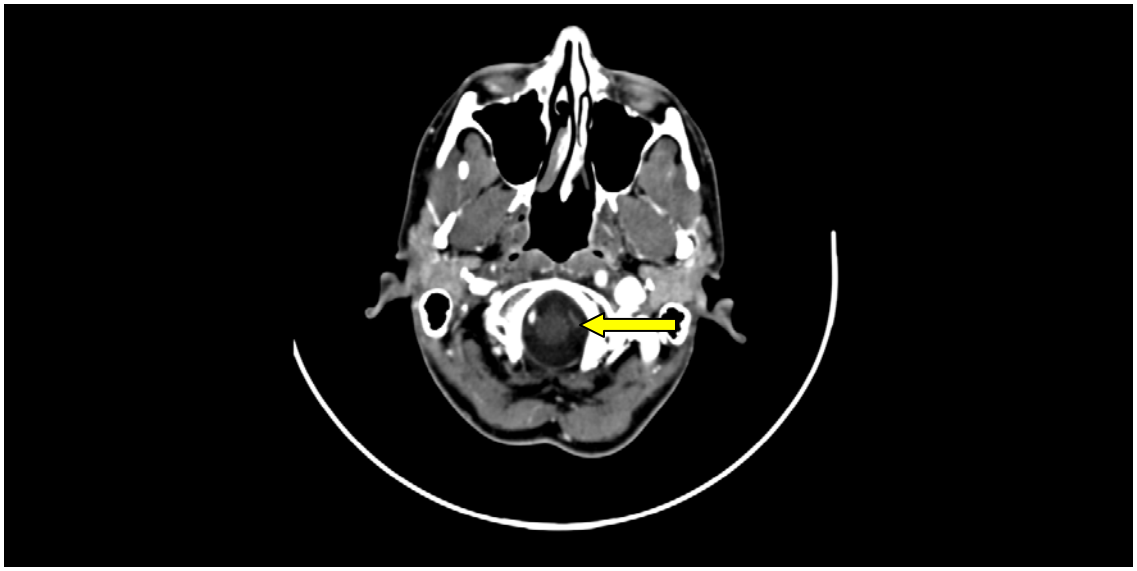


Figure 3: Chronic medullary stroke on axial view of FLAIR MRI

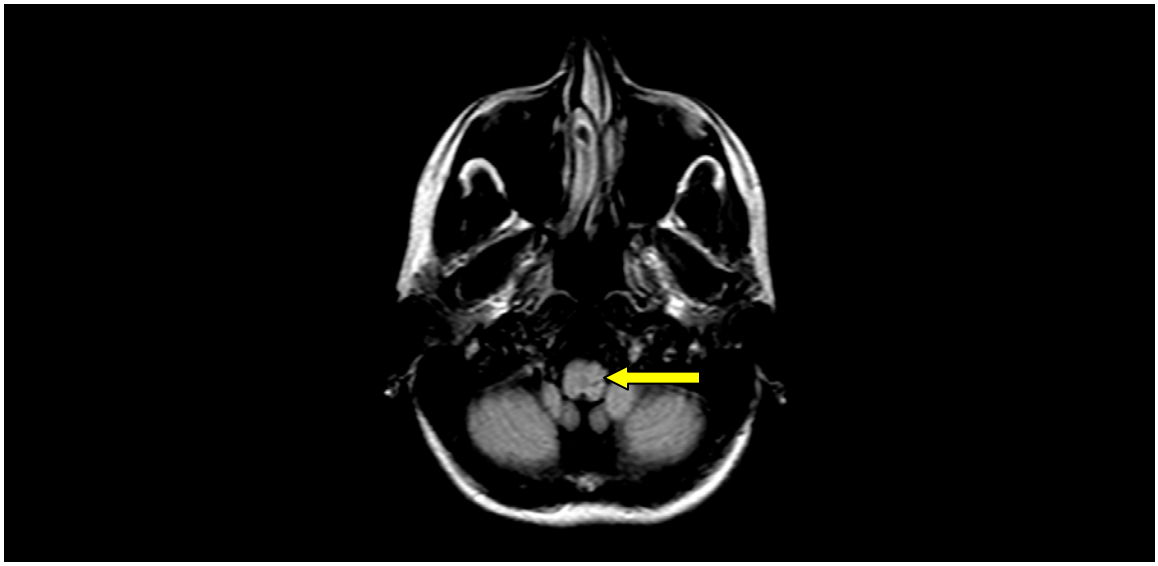
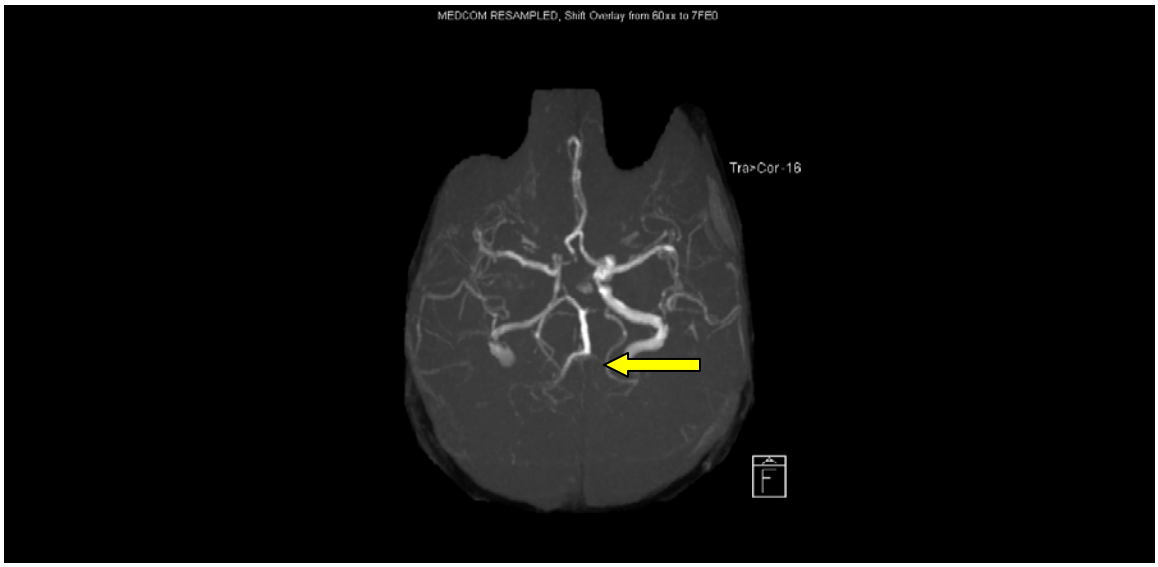


Figure 4: Intracranial time-of-flight MRA showing absence of flow in the left vertebral artery



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