Contralateral Tongue Deviation Due to Paramedian Pontine Infarction: A Brief Review of Cortico-Hypoglossal Projections

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Patient: Male, 81-year-old
Final Diagnosis: Stroke
Symptoms: Right-sided hemiparesis • right lower facial droop • dysarthria • tongue deviated to the right side without fasciculation or atrophy
Medication: —
Clinical Procedure: —
Specialty: Neurology

Objective: Rare disease
Background: Motor function of the tongue is controlled by the hypoglossal nucleus (the lower motor neuron) and its supranuclear innervation (the upper motor neuron). Tongue deviation due to muscle weakness on one side is common in brain stem stroke and is usually associated with dysarthria and dysphagia that decrease the patient’s quality of life. This case report presents a typical but rarely discussed case of tongue deviation secondary to a brain stem stroke. In addition, it also offers a concise review of both the ipsilateral and the contralateral cortico-hypoglossal fibers that innervate the hypoglossal nucleus. Even though the direction of the tongue deviation offers essential clues to localizing the brain lesion, many providers lack experience and knowledge in this area.

Case Report: We report the case of an 81-year-old right-handed male patient with right-sided hemiparesis, right lower facial droop, dysarthria, and tongue deviated to the right side without fasciculation or atrophy. The Babinski sign was positive on the right. Magnetic resonance imaging revealed an infarct in the left paramedian pontine. Since both the tongue deviation and the hemiparesis were right-sided, contralateral to the side of the lesion, we concluded that the lesion affected the cortico-hypoglossal fibers and the corticospinal fibers prior to their decussations.

Conclusions: The case report reviews the projections of the corticospinal fibers. Each hypoglossal nucleus receives input from both hemispheres, with the contralateral descending fibers passing through the medial part of the ventral pons and the ipsilateral descending fibers passing through the more lateral aspect of the pons. The decussation is generally located at the pontomedullary junction, with exceptions due to individual variance.

Keywords: Ischemic Stroke • Hypoglossal Nerve • Embolic Stroke
Background

Motor function of the tongue is controlled by the hypoglossal nucleus (the lower motor neuron) and its supranuclear innervation (the upper motor neuron) [1]. Tongue deviation due to muscle weakness on one side is a common symptom resulting from a stroke in the brain stem and is usually associated with dysarthria and dysphagia that decrease the patient’s quality of life. We present a case of a patient with tongue deviation that resulted from a paramedian pontine infarction that affected the contralateral cortico-hypoglossal fibers, with 3 purposes: 1. To highlight to providers the typical but rarely discussed patterns of the direction of the tongue deviations compared to the side of limb weakness in brain stem strokes. 2. To stress the point that relevant clinical findings can help localize the lesion. 3. To review the general anatomy of cortico-hypoglossal projections and how it affects the motor control of the tongue when lesions occur.

Case Report

An 81-year-old right-handed man, with past medical history pertinent for patent foramen ovale, hypertension, hyperlipidemia, and transient ischemic attack, presented to the hospital with right-sided weakness and slurred speech upon waking up in the morning. The patient called 911 and was transferred to the Emergency Room (ER) by the Emergency Medical Service (EMS). The EMS reported a new onset of atrial fibrillation episode en route to the hospital. At the ER, a physical examination revealed right-sided hemiparesis, right lower facial droop, dysarthria, and tongue deviated to the right side, without fasciculation or atrophy. The Babinski sign was positive on the right. A brain magnetic resonance imaging scan revealed diffusion-weighted imaging hyperintensity with apparent diffusion coefficient correlate in the left paramedian pontine (Figure 1), indicating acute infarction, as well as chronic bilateral cerebellar hemispheric encephalomalacia. A venous duplex ultrasound was positive for deep venous thrombosis in one of the 4 gastrocnemius veins. A brain computed tomography perfusion scan showed no core tissue. The patient was previously on aspirin and clopidogrel as dual antiplatelet therapy, given his history of transient ischemic attack. He was switched to apixaban upon the discovery of deep vein thrombosis and atrial fibrillation. The etiology of the stroke was mostly atheromatous in origin. Other differentials included cardioembolic origin; however, it is less likely, as a cardiac embolism obstructing only a perforating artery of the basilar artery is rare [2]. Because the patient’s tongue deviated to the right side without atrophy or fasciculation, the hypoglossal nerve palsy was presumed to be supranuclear in origin. In addition, the patient’s hemiparesis was also right-sided, ipsilateral to the direction of the tongue deviation, contralateral to the lesion of the left paramedian pontine. Considering all of the above, it was concluded that the lesion affected the descending fibers of the corticospinal tract prior to its pyramidal decussation and the cortico-hypoglossal fibers prior to its decussation at the pontomedullary junction. The patient’s speech, limb movement, and tongue deviation had improved considerably on Day 8 of...
hospitalization. The patient was discharged to a rehabilitation center and was expected to recover most of his motor functions after physical therapy.

Discussion

The hypoglossal nucleus is located at the medial medulla beneath the fourth ventricle [1]. The hypoglossal nerve, also known as cranial nerve 12, travels from the hypoglossal nucleus to the tongue and innervates the tongue muscles on the ipsilateral side. An infarct in the medulla typically damages the lower motor neuron for voluntary motor control of the tongue and results in a tongue deviation toward the side of the lesion due to muscle weakness. The hypoglossal neuron is innervated by cortico-hypoglossal fibers (the upper motor neuron). It is widely accepted that the corticobulbar fibers for the voluntary control of the tongue originate in the peri-Sylvian area of the motor homunculus, descend through the corona radiata, internal capsule, and cerebral peduncle and cross the midline at the pontomedullary junction [3]. If the lesion site is rostral to the decussation, it will create a tongue deviation contralateral to the side of the lesion. Most brain stem lesions involve the pyramidal tract; the decussation of the pyramidal tract exists in the caudal medulla, beneath the most accepted decussation of the cortico-hypoglossal tract at the pontomedullary junction. As a result, a brain stem lesion affecting the upper motor neurons of both the tongue and the limb movements will typically present as an “uncrossed hemiparesis”, with the tongue deviated to the side of the limb weakness, contralateral to the side of the brain lesion [4]. This is the most common pattern of tongue deviation in a brain stem infarct and the pattern that our patient presented with.

However, exceptions to the above pattern exist. First, the hypoglossal nucleus receives inputs from both hemispheres [1]. For example, the hypoglossal nucleus in the left medulla receives inputs from both the left and the right hemispheres. The cortico-hypoglossal fibers innervating the contralateral hypoglossal nucleus pass through the medial part of the ventral pons before decussation, while the cortico-hypoglossal fibers innervating the ipsilateral hypoglossal nucleus pass through the lateral part of the pontine without crossing the midline [3]. Second, variations in the cortico-hypoglossal fibers decussation location have been reported. For instance, a case report by Tomita et al demonstrated a patient had an infarction involving the ventromedial portion of the right medulla presented with tongue deviation and hemiparesis that were both left-sided, indicating the crossing point of the cortico-hypoglossal fibers exist caudally to the lesion, deviating from the commonly depicted decussation location at the pontomedullary junction [5]. In summary, an infarction involving the brain stem can result in a tongue deviating on protrusion to the side either ipsilaterally or contralaterally to the side of the lesion, depending on whether the lesion affects the lower motor neuron, the contralateral upper motor neuron before or after the decussation, or the ipsilateral upper motor neuron. Generally, the cortico-hypoglossal fibers cross the midline at the pontomedullary junction; however, individual variations have been reported (Figure 2).

Conclusions

This case report with a concise review of the cortico-hypoglossal fibers makes it possible for clinicians to locate the lesion using information obtained from a physical examination when a brain imaging study is not readily available.

Institution Where Work Was Done

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Declaration of Figures’ Authenticity

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