

# A Case of Isolated Unilateral Glossopharyngeal Nerve Palsy

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**ABSTRACT:**

Isolated palsy of the glossopharyngeal nerve is rare. We report the case of an elderly patient with unilateral right glossopharyngeal nerve palsy secondary to extra cranial ischemia. On examination there was no other deficit other than an absent right gag reflex. We diagnosed her with ischemic stroke of the ninth nerve clinically and increased her daily dose of Aspirin from 81 mg to 325 mg. The magnetic resonance imaging of the brain showed a normal brainstem and cerebellum with patent intracranial circulation. Total resolution of the paralysis was seen two months later. The possible mechanisms suspected are diabetic or hypertensive stenosis of the vasa nervorum or compression of the ninth nerve by an internal carotid artery dissection or aneurysm. This article discusses the various etiologies and mechanisms of this rare condition. It is unique because of the nerve's location and relation to other structures.

**KEYWORDS:** Dysarthria; Gag reflex; Glossopharyngeal nerve; Internal Carotid Artery; Superior Constrictor muscle; Stylopharyngeus muscle

**INTRODUCTION:**

Isolated glossopharyngeal nerve palsies (IGNP) are almost unheard of. This is due to its proximity to other structures such as the eighth, tenth and eleventh cranial nerves (Fig 1 and Fig 2). IGNP can occur from damage to the medulla at its exit, across the cerebellopontine angle and the flocculus, its sensory ganglion at the jugular foramen, as it crosses the internal carotid artery anteriorly in the neck, at the styloid process located posterolaterally or at the pharyngeal plexus in the posterior pharyngeal wall (PPW). Unilateral peripheral motor neuron causes are grouped into medullary, intracranial and extra cranial. Vascular pathology at the medulla is more common than posterior fossa neoplasia and syringomyelia. Intracranial lesions from the medulla to the jugular foramen include inflammation such as meningitis, jugular foramen neuromas, glomus jugular tumor, sigmoid venous thrombosis and basilar skull fractures. Ischemia, infection, compressions from retropharyngeal spaces and internal carotid artery dissection are few plausible extra cranial causes. Myoneural junction lesions are mainly bilateral and thus not an etiology for IGNP.

**CASE HISTORY:**

A 71-year-old woman with hypertension, type 2 diabetes mellitus, hyperlipidemia who was a former tobacco smoker was referred to us for speech difficulties. The difference in her speech was first noticed by an orthopedist, a month ago when she went for a follow up appointment. Apart from mild dysphagia to liquids, there was no history of nasal regurgitation, taste changes or other cranial nerve and neurological deficits. Other minor history was occasional dizziness and reduced hearing that we attributed to vertigo and senile hearing impairment. On examination, she was afebrile, normotensive and dysarthric. She scored a 1 on the NIH stroke

scale. It was difficult to assess her speech changes as we did not know her baseline. She could not repeat the words "Thanks" and "Huckleberry" clearly but she was able to repeat "Mama", "Tip-top", "Fifty-fifty" and "Baseball player". There was absence of bilateral contraction of the PPW after a right PPW stimulus. She had left sided elevation of the PPW on touching the left PPW. Movement of the tongue and facial muscles were intact. With consent a picture and a video of the gag reflex were obtained (though not presented as of poor quality). The rest of her cranial examination and neurological examination was unremarkable except for a positive Dix Hall pike maneuver of the left.

A magnetic resonance imaging of the brain done had nonspecific findings of a tiny old lacunar infarct of the left thalamus, left inferior basal ganglia perivascular dilation with periventricular and subcortical white matter hyper intensities. No clear medullary involvement was seen. MR angiography was non specific. Glycemic indices were high with an HbA1c of 11.2%.

## **DISCUSSION:**

The glossopharyngeal nerve is mainly sensory though a mixed cranial nerve. The motor root of the ninth nerve, that supplies both the stylopharyngeus and the lateral portion of the superior constrictor muscle, takes origin from the nucleus ambiguus of the medulla; the parasympathetic fibers to the parotid gland travel via the inferior salivatory nucleus and the taste fibers from the posterior third of the tongue synapse in the nucleus of tractus solitarius.<sup>3</sup>The superior and petrosal ganglion of the ninth nerve receive the sensory fibers that synapse in the thalamus and cortex via the spinal nucleus of the trigeminal nerve.<sup>3</sup> They innervate the tonsils and its fauces, posterior pharynx, soft palate, posterior third of the tongue, carotid glomus and sinus, pinna and

external auditory canal.<sup>3</sup> Supranuclear innervations from the precentral gyrus to the above nuclei are partly crossed and partly uncrossed. The ninth nerve and its muscles, the stylopharyngeus and lateral portion of the superior constrictor muscle, are supplied by the branches of the ascending pharyngeal artery of the external carotid system.<sup>1</sup> The ninth nerve is also supplied by the vertebrobasilar system.<sup>26</sup>

The anatomy of the pharyngeal wall and the innervation is unclear and several studies done have revealed different innervation patterns in these muscles.<sup>18, 19, 20</sup> Even the physiology of the gag reflex is ambiguous. Few account for an afferent glossopharyngeal that synapses in the ipsilateral nucleus ambiguus and sends out its efferent via the vagus.<sup>2</sup> Others describe an intervening spinal nucleus and trigeminothalamic tract that receives the afferent impulses of the ninth and sends it to bilateral nucleus ambiguus, resulting in bilateral contraction of the PPW.<sup>3,8</sup> The motor response is generally unclear and includes pharyngeal contraction with or without contraction of the medial aspect of the posterior pharyngeal wall, elevation of the soft palate, tearing, withdrawal of the head, coughing and retching.<sup>14</sup> The visible portion of the gag reflex is the medial portion of the superior constrictor muscle (SCM), innervated by the pharyngeal branch of vagus (X-ph).

A unilateral absence of gag reflex with an intact uvula, symmetrical palatal elevation, midline tongue and lack of hyper nasal speech and hoarseness of voice, signifies a lower motor neuron ninth nerve palsy, mainly ninth sensory defect. We suspect an extra cranial affect as medullary involvement would typically include multiple nerves which are the taste fibers of the tractus solitarius, 9th, 10th, 11th and 12th cranial nerve palsy. (the 9<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> cranial nerves arise

from the nucleus ambiguus; the nucleus tractus solitarius and the 12<sup>th</sup> nerve motor nucleus also lie in the medulla). The absence of other cranial nerve involvement and a negative magnetic resonance brain imaging points towards an extra cranial lesion, of either nerve or muscle. We suspected an ischemic basis with differentials being diabetes or hypertension predominantly affecting the vasa nervorum or Schwann cell.

Cranial neuropathies are extremely rare (0.05% or 0.05 per 100 cases).<sup>15</sup> However, persons with diabetes have a 29% higher risk of being affected than do persons without diabetes with regards to Bell's palsy.<sup>33</sup> Age more than fifty years, long term illness from diabetes, poorly controlled diabetes as in our patient and diabetes itself are risk factors for cranial neuropathy. However, early occurrence in diabetes has been reported with poorly controlled sugars.<sup>21</sup> Other clues to diabetic neuropathy are co-existing retinopathy or nephropathy, which were not present in my patient. Most diabetic cranial nerve palsies involve III, IV, VI and VII nerves with spontaneous resolution in two to three months.<sup>9</sup> Neurovascular damage from stenosis (local embolization or diabetic vasculopathy of the vasa nervorum) and hyperglycemic neuronal damage. is the proposed mechanism in diabetic cranial neuropathy. AKR1B1 (aldo-keto reductase family 1 member B) polymorphisms might also influence the decline of nerve function. Diabetic vasculopathy consists of thickening of the basement membrane and destruction of the blood nerve barrier from inflammation. This impairs tissue perfusion, causes red blood cell seepage and ensuing local edema with endoneurial and perineurial vasculitis.<sup>22</sup> Local embolization from local inflammation results in focal nerve hypoxia causing either segmental demyelination or wallerian degeneration.<sup>29</sup> However, local or distal embolization of one arteriole, would not explain ischemia of the nerve as there is generally good collateral circulation available within the

nerve. Vasculopathy could also be from hypertension induced basement membrane hyalinization.<sup>29</sup> Neuronal damage from hyperglycemia could be from polyol flux pathway as it explains the reversibility of symptoms despite long standing diabetes, unknown glycemic status and lack of any metabolic control intervention by us. However, hypoxic ischemia of damaged vessels and capillaries is favored over polyol flux theory for cranial nerve palsies.<sup>25</sup> Schwann cell damage without axonal injury can occur. This is the most likely structure to be affected as it is the closest structure to the blood nerve barrier, is most sensitive to hypoxia and toxic metabolites; injury can be reversed within three months, if no AGE molecules have set in.<sup>27, 29</sup>

Compression of the ninth nerve alone from internal carotid artery dissection and aneurysm have been reported. Hematoma at the pre-petrosal (C2 level) level of the internal carotid artery affects only the 9<sup>th</sup> nerve sparing the other cranial nerves with 50% of them presenting with Horner's syndrome.<sup>17</sup> Extracranial internal carotid artery aneurysm affecting only the ninth nerve has been reported.<sup>28</sup> Hematomas or aneurysms could either compress or stretch the nerve causing segmental demyelination which is reversible in three months.<sup>27</sup> Segmental demyelination occurs by intussusception of the internodes at the site of pressure into the adjacent myelin sheath.<sup>24</sup> Interruption of the nutrient vessels supplying the nerve is also suspected but to a lesser extent, due to dual innervation of the ninth nerve at the jugular foramen and pre-petrosal area and rich collaterals within the nerve.(Dual innervation from the vertebrobasilar system and the external carotid system comprising of the ascending pharyngeal or occipital or middle meningeal arteries).<sup>26</sup>

Lyme's infection is also possible given an endemic area but the resolution of symptoms without the need of antibiotics, the absence of a classic history and the infrequent involvement of lower cranial nerves makes it less likely.<sup>7</sup> Lyme's testing was negative as well in our patient. The possibility of a pure dysarthria was not considered at this point because of the absence of a hyperactive gag reflex and an insignificant brain imaging. Ischemic stylopharyngeus does not have clinical relevance as it functions as a pharyngeal elevator in conjunction with the other pharyngeal muscles and cannot be separately identified or tested. The lesion can also be idiopathic.

Based on the theory of bilateral motor response of the gag reflex, absence of right PPW contraction on applying left pharyngeal stimulus could also mean unilateral paralysis of the right SCM from ischemia to the right X-ph. However we disagree with this possibility in our patient for the following reasons. Based on a fetal study, SCM and palatopharyngeus (PP) are connected in fetal life, hence their nerve should be common (based on Shimokawa's concept).<sup>19,20</sup> Thus ischemia to the X-ph branch, being a common nerve, would also affect the PP presenting as hyper nasality, soft palate paresis and nasal regurgitation unilaterally, which were absent in our patient. Arterial ischemia of SCM is unlikely due to rich anastomosis between the arteries of this region. Pure ninth (motor) nerve lesion would not affect the motor response as it innervates the lateral hidden portion of the SCM. Of note, it is interesting to point out that that most pharyngeal studies have been done in Korea and Japan.

Lastly, the most interesting point to note is the role of an orthopedic surgeon in the diagnosis. This raises the question of the frequency of the occurrence of dysarthria seen in the field of

orthopedics. There have been occurrences and is thus a potential topic to explore.<sup>10, 11</sup> Our orthopedist was astute enough to pick up on the change in voice to trigger a referral.

Other points to highlight would be the following:

- > An absent unilateral gag reflex suggests an abnormality unlike an absent bilateral gag reflex which is seen in healthy individuals.<sup>30</sup>
- > Hypertension from baroreceptor reflex damage would be a feature of bilateral ninth nerve lesions rather than unilateral.
- > Compressions such as internal carotid artery dissections or aneurysms must be considered and ruled out as the evidence is easily obtainable.
- > In 8% of population, ninth nerve palsy can present with nasal regurgitation, due to common motor nerve supply to the levator veli palatini (LVP) and SCM. In such instances LVP does not receive X-ph nerve innervation.<sup>20</sup>
- > Aspirin, insulin and alpha lipoic acid (ALA) have been tried in the treatment of diabetic cranial nerve palsies.<sup>4,5,16</sup> Near complete resolution was seen within three weeks of intensive insulin therapy in type 2 diabetics. Significant improvement occurred within ten days of ALA therapy. Aspirin was ineffective in prevention. The best preventive therapy is optimum glycemic control.
- > Intensive insulin therapy speeds recovery compared to conventional insulin therapy by five months.<sup>4,21</sup> Conventional insulin therapy is equivalent to spontaneous remission based on duration of resolution (three to six months).<sup>9,21</sup>
- > Medical therapy with anti platelet agents was sufficient in treating carotid dissection cranial palsy.<sup>6</sup>

> Glucocorticoids help preserve the blood nerve barrier by up-regulating the expression of junctional protein – claudin.<sup>23</sup>

## **CONCLUSION:**

Differentials of diabetic or hypertensive vasculopathic changes should be considered in the evaluation of isolated glossopharyngeal nerve palsy in the absence of other suggesting lesions. Other differentials to consider are compressive neuropathy (nerve or schwann cell) or compressive ischemia, Lyme's neuritis and idiopathic. Recovery can be quickened by 2 months with supportive therapy with nerve nutrients and intensive insulin. Despite several recent studies on pharyngeal muscles innervation, the anatomy is unclear. The following main points remain - unilateral absent gag reflex is abnormal and mainly a ninth sensory lesion. Rarely it can be accompanied with nasal regurgitation (LVP paresis). Palatal paresis, hyper nasality and nasal regurgitation is mainly a feature of tenth pharyngeal nerve lesion. A proper understanding of the gag reflex in humans needs to be achieved.

Note:

### **What's new?**

**Unilateral** palsy of glossopharyngeal nerve from **diabetic** ischemia.

Gag reflex physiology requires additional studies regarding prevalence of bilateral and unilateral motor response.

### **Clinical relevance?**

Consider carotid dissection or aneurysm in elderly patients while making a diagnosis.

Consider glucocorticoid therapy for ninth nerve palsy.

**What was known before?**

IGNP from exercise, otogenic sepsis, trauma (neck), internal carotid dissection and aneurysm, tonsillectomy, head and neck surgeries. (Source –PubMed)

Ninth nerve palsy frequently seen with multiple nerves especially lower cranial nerves (source - PubMed)

**ABBREVIATIONS:**

Isolated glossopharyngeal nerve palsy (IGNP)

Posterior pharyngeal wall (PPW)

Superior constrictor muscle (SCM)

Pharyngeal branch of vagus (X-ph)

Levator veli palatini (LVP)

Alpha lipoic acid (ALA)

Palatopharyngeus (PP)

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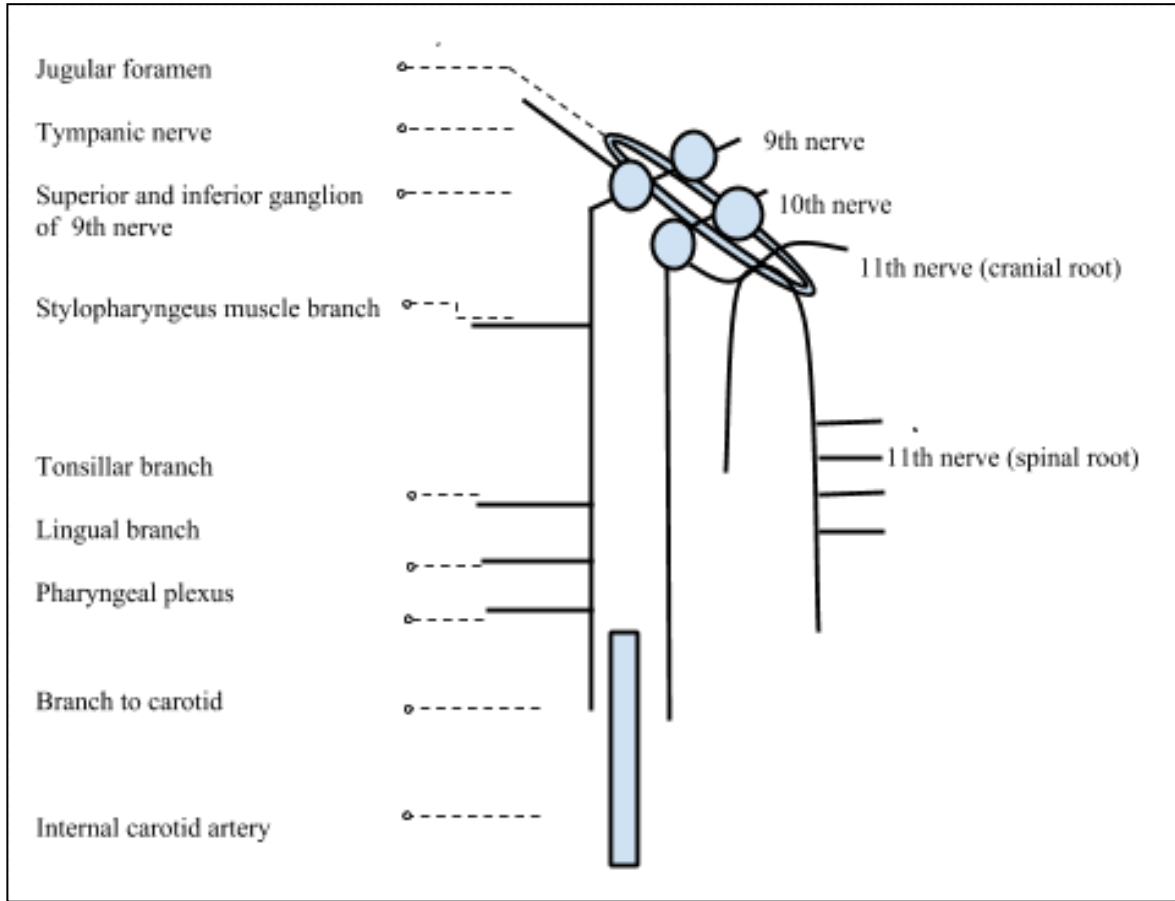
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**Fig 1:** Schematic drawing depicting the extra cranial ninth cranial nerve with its branches and posteromedial relations.<sup>(3,13)</sup>



**Figure 2:** Schematic drawing showing a cross section of the **medulla** illustrating the nuclei and the intracranial relations of the ninth nerve.<sup>(3,12)</sup> (1) Spinal nucleus of the trigeminal; (2) Ponto medullary junction; (3) Eighth cranial nerve with cerebellopontine relation to the ninth nerve; (4) Dorsal motor nucleus; (5) Inferior salivatory nucleus; (6) Nucleus tractus solitarius-upper third to the ninth nerve and middle third to the vagus; (7) Nucleus ambiguus; (8) Flocculus of the cerebellum; (9) Glossopharyngeal rootlets; (10) Vagus nerve; (11) Pyramid; (12) Inferior Olivary nucleus.

