

# Pure Sensory Lacunar Infarction in the Thalamus Presented as Bilateral Hypogeusia: A Case Report

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## Abstract

**Purpose:** While the gustatory pathway of animals has been well-researched, that of humans is still a mystery. Several theories have been established, and some earlier reports hypothesized the relation to laterality. However, some cases could not be fully explained by the laterality theory<sup>(1)</sup>. To clarify the gustatory pathway, we reported a case with bilateral hypogeusia after right thalamic infarction.

**Case:** This 55-year-old, right-handed man suffered from sudden decreased sensitivity of taste. He was unable to differentiate sweetness and saltiness at bilateral anterior parts of tongue. Additionally, there was numbness at the upper palate and the lips. Neurological examination revealed decreased taste sense at both sides of his anterior tongue and decreased pin-prick sensation of the left part of his lips. Brain magnetic resonance imaging (MRI) revealed acute ischemic stroke at the right ventral posteromedial nucleus (VPM). Thus, single antiplatelet therapy was administered. Two weeks later, the symptoms improved significantly and completely recovered without sequelae.

**Conclusion:** The exact gustatory pathway in humans remains uncertain nowadays. First, there were few reports about dysgeusia, which might be related to clinical neglect of taste deficits. Second, our knowledge of the human gustatory pathway depends solely on sporadic cases of taste-involved brain lesions. We reported a case of bilateral hypogeusia after right thalamic infarction. This finding indicates that, although there might be laterality of gustatory fibers to the left hemisphere, anatomical variations may exist in the human gustatory system. More research is needed to elucidate the understanding of the gustatory pathway in humans.

**Keywords:** central gustatory pathway, bilateral hypogeusia, laterality, thalamic infarction

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## INTRODUCTION

While the gustatory pathway in some animals has been

well-explored, our comprehension of the gustatory system in humans is scarce. Taste dysfunction involving the human gustatory pathway was not reviewed completely.

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Several theories have been established, and the relation to laterality of gustatory function at left hemisphere has been hypothesized from the earlier reports<sup>(1)</sup>. However, some cases could not be fully explained. We reported a rare case: a patient with bilateral hypogeusia after right thalamic infarction.

## CASE

This 55-year-old, right-handed man, with history of type 2 diabetes mellitus, hyperlipidemia, and hypothyroidism, suffered from sudden loss of taste. He could not differentiate sweetness and saltiness at bilateral anterior parts of his tongue. Additionally, there was numbness at his upper palate and the lips. He had no olfactory loss, which could potentially induce taste disturbance. Hence, he visited our Neurology outpatient clinic for help.

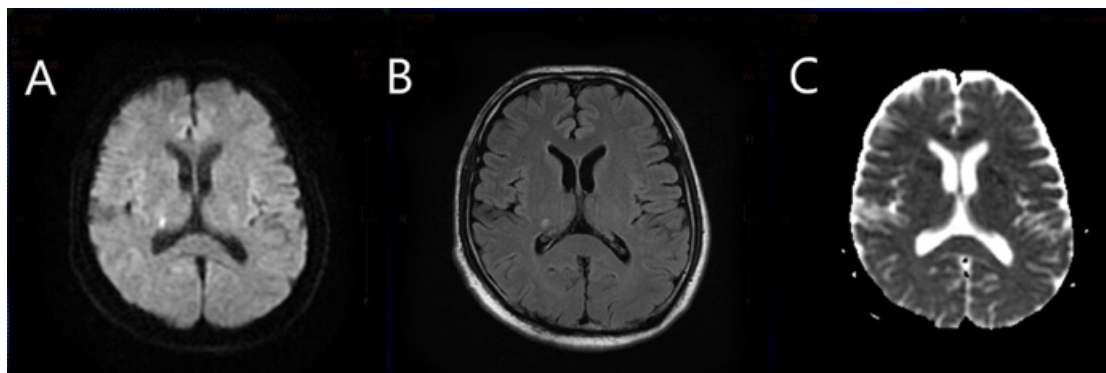
Neurological examination revealed decreased taste sense at both sides of his anterior tongue and decreased pin-prick sensation at the left part of his lips. Neither limb deficit nor language disturbance was found. Brain computed tomography (CT) images didn't disclose abnormal finding. Brain magnetic resonance imaging (MRI) showed hyperintensity in diffusion weighted imaging (DWI) and hypointensity in apparent diffusion coefficient (ADC) at the ventral posteromedial nucleus (VPM) of the right thalamus (Figure 1). Acute ischemic stroke at the right VPM was impressed. Thus, we prescribed single antiplatelet therapy. Two weeks later, the symptoms improved significantly and then completely recovered without sequelae.

## DISCUSSION

According to contemporary knowledge, the gustatory pathway starts from the taste buds to reach the solitary nucleus, including fibers from the facial, glossopharyngeal, and vagus nerves. Relay neurons from the solitary nucleus form the medial lemniscus, which ascends ipsilaterally through the pons and midbrain, arriving at the thalamus. It then projects to the parietal operculum and insular cortex<sup>(2-4)</sup>. However, whether the nerve fibers go ipsilaterally, cross to contralateral side, or walk bilaterally to the cortices, remains to be discussed.

In animal studies, the pathway above the pons varied among species. Both rats' and macaque monkeys' central gustatory pathways ascend from the rostral part of the solitary nucleus to the pons ipsilaterally. The pathway differs after the nerve fibers passing the pons. The gustatory fibers in rats branch and ascend bilaterally to the thalami, projecting to the insular cortices. While in the macaque monkeys, the fibers ascend only to the ipsilateral thalamus and insular cortex<sup>(4-6)</sup>. Therefore, whether the pathways of animals could apply to humans is questionable.

As for humans, early research supports the theory of laterality that the left hemisphere is more dominant in taste sensorium than the right one. Bilateral dysgeusia occur more frequently in patients with left thalamic stroke, while unilateral dysgeusia is observed after right thalamic stroke<sup>(1)</sup>. However, our reported case got bilateral hypogeusia after right thalamic stroke. It suggested that another possibility of central gustatory pathway in humans might exist.



**Fig. 1.** The brain MRI revealed acute ischemic stroke at the VPM of the right thalamus: (A) hyperintensity in DWI, (B) hyperintensity in T2-Flair (fluid-attenuated inversion recovery), and (C) hypointensity in ADC.

From the database in PubMed, we collected the published articles since 1990, discussing lesions causing taste dysfunction (Table 1). We found that unilateral supratentorial lesions tend to cause bilateral or unilateral taste disorders in different patients, while unilateral brainstem lesions below the midbrain or the pons tend to cause ipsilateral taste problems (Table 2). From another report in 2017<sup>(7)</sup>, we learned that the most rostral area causing ipsilateral hemiageusia is in the ipsilateral rostral midbrain, which also supports the conclusion from Table 2. Therefore, the convergent point in the gustatory pathway might locate above the rostral midbrain and adjacent to or below the thalamus.

Previous research supports the theory of laterality that

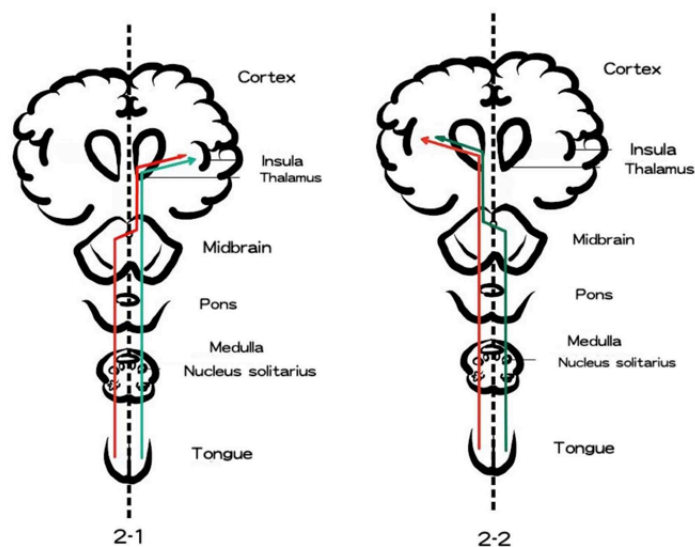
the left hemisphere is more dominant in taste sensorium than the right one<sup>(1)</sup>. Gustatory fibers from both sides of the tongue ascend ipsilaterally to the midbrain, then going toward the left hemisphere chiefly (Figure 2). However, the gustatory pathway of our patient is different from that of most people. Our reported case, who got bilateral hypogeusia after right thalamic stroke, is one of the rarely seen cases of bilateral taste loss associated with acute right unilateral thalamic infarction (Table 1). We hypothesize that there might be variations in humans. We need to consider the possibility that the gustatory fibers ascend from bilateral sides of the tongue and reach the right thalamus mainly, rather than going to the left thalamus (Figure 2).

**Table 1.** Cases with lesions involving dysgeusia since 1990

Case	Year	Age	Gender	Side of taste disorder	Location	Cause
A. Pascual-Leone <sup>(8)</sup>	1991	25	X	Right hemiageusia	Right medulla	Multiple sclerosis
S. Hisahara <sup>(9)</sup>	1994	37	M	Left dysgeusia	Right tegmentum of the midbrain	X
Y. Shikama <sup>(10)</sup>	1996	37	F	Left dysgeusia	Left tegmentum of the midbrain	AVM
	1996	65	F	Right hemiageusia	Medial portion of right midbrain, lateral portion of the fight cerebral peduncle, right thalamus	Infarction/hemorrhage
M. Fujikane <sup>(11)</sup>	1998	67	M	Right hypogeusia	Left suprapontine tegmentum	Infarction
Y. Kojima <sup>(12)</sup>	1999	71	F	Right hypogeusia	Right tegmentum of the middle pons	Hemorrhage
K. Onoda <sup>(13)</sup>	1999	29	F	Right hypogeusia	Right tegmentum of the pons	Infarction
	1999	65	M	Right hypogeusia	Left thalamus	Infarction
	1999	68	M	Right hypogeusia	Left internal capsule	Infarction
K. Sato <sup>(14)</sup>	2000	58	F	Right ageusia	Right dorsolateral tegmentum of the middle pons	Demyelinating lesion
S. Takeuchi <sup>(15)</sup>	2006	72	M	Left ageusia	Left middle cerebellar peduncle	Infarction
H. Ito <sup>(16)</sup>	2006	39	M	Bilateral ageusia	Left putamen and edema affecting the insular cortex	Hemorrhage
J. E. Kim <sup>(1)</sup>	2007	62	M	Bilateral ageusia	Left thalamus	Infarction
T. Yonekawa <sup>(17)</sup>	2007	9	F	Right anterior ageusia	Right VPM	Multiple sclerosis
M. Nakajima <sup>(18)</sup>	2010	40	X	Bilateral ageusia	Left paramedian Thalamus	Infarction
G. Tsivgoulis <sup>(19)</sup>	2011	32	M	Bilateral ageusia	Right central tegmental tract and VPM	Infarction
E. S. Ribas <sup>(20)</sup>	2012	61	F	Bilateral ageusia	left temporoinsular region	Low-grade glioma, post tumor removal
T. Hashimoto <sup>(21)</sup>	2012	49	F	Bilateral hypogeusia	Right tegmentum of the midbrain	Suspect multiple sclerosis
S. Kogawa <sup>(22)</sup>	2013	58	M	Bilateral ageusia	Right paramedian Thalamus	Infarction
C. Saleh <sup>(23)</sup>	2018	68	M	Bilateral ageusia	Left mesencephalon	Infarction
F. Mag Uidhir <sup>(24)</sup>	2021	68	F	Bilateral hypogeusia	Right thalamus	Infarction
Our case	2022	55	M	Bilateral hypogeusia	Right VPM	Infarction

**Table 2.** Data compiled from Table 1.

Site of the lesions		Side of symptoms		
		Ipsilateral	Contralateral	bilateral
Brainstem: below the pons		5	1	0
Brainstem: Midbrain		2	1	3
Supratentorial	Left	0	2	4
	Right	1	0	3

**Table 2.** Lesions below the pons tend to cause ipsilateral symptoms, while lesions above the midbrain tend to cause bilateral symptoms.**Fig. 2.** The predominant site of gustatory function was suggested to be at left hemisphere (Figure 2-1), but our case was suspected to be a variant with predominance at right hemisphere (Figure 2-2).

## CONCLUSION

Because of clinical neglect of taste deficits and sporadic cases of taste-involved brain lesions, the explicit gustatory pathway in humans remains inconclusive. We reported a case of bilateral hypogeusia after right thalamic infarction. Although there might be laterality of gustatory fibers to the left hemisphere, our finding indicates that anatomical variations may exist in the human gustatory system. More research is needed to expound the gustatory pathway of humans and to provide more clues to clinical localization.

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