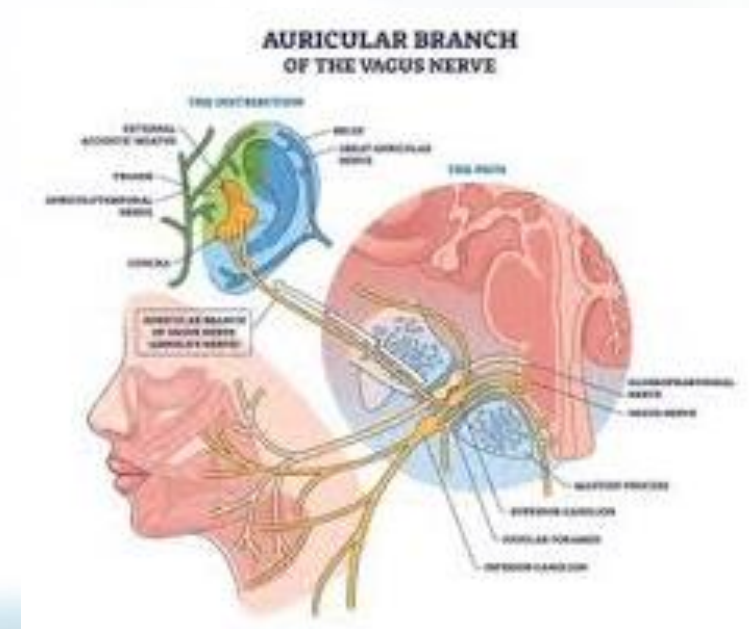
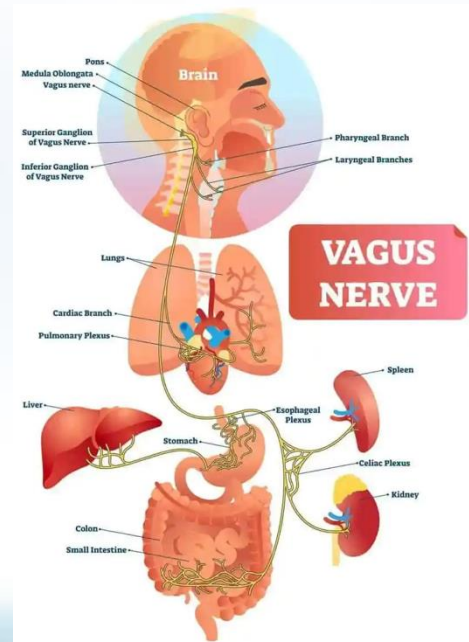


Auricular branch of vagus nerve



Auricular branch of vagus nerve (ABVN)

- The vagus nerve is a mixed nerve (containing sensory, motor, and parasympathetic fibers).
- The auricular branch of the vagus nerve is not a mixed nerve, it is purely sensory.
- The auricular branch of the vagus nerve is one of the branches of the vagus nerve and it is the only sensory branch of the vagus nerve on the body surface.



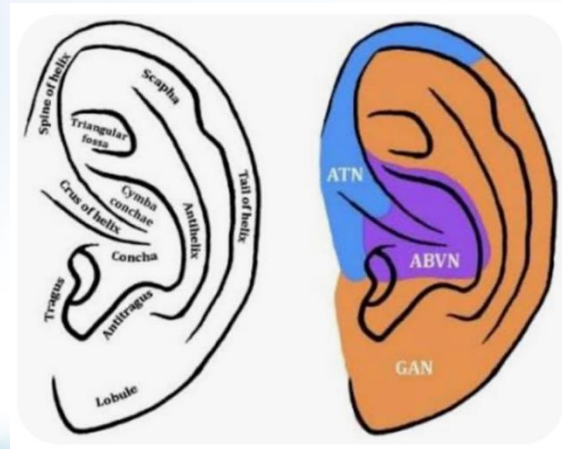
Auricular branch of vagus nerve (ABVN)

- **The Anatomical pathway:** The ABVN originates from the superior vagus ganglion at the jugular foramen, and passes through the bony passage of the mastoid canal of the temporal bone, distributes in the skin of the ear.
- **Distribution:** The concha (cymba conchae, cavum conchae), the inner surface of the tragus, the posterior wall of the external auditory canal, and the outer surface of the tympanic membrane.
- **Signal Transduction Mechanism:**
 - Ear Stimulation: Stimulation of the cymba conchae, cavum conchae etc..
 - Afferent Signals: The ABVN transmits sensory signals to the superior vagal ganglion, then enters into the medulla oblongata, and subsequently ascends to the cerebral cortex.
 - Central Integration: The signal projects to the nucleus tractus solitarius in the medulla oblongata, where it synapses with second-order neurons.
 - Descending Regulation: Activated signals activate brainstem structures such as the nucleus tractus solitarius, regulating the parasympathetic nervous system and influencing cardiac, pulmonary, and gastrointestinal functions.



Distribution area of sensory nerves in the ear

- **The cymba conchae and cavum conchae:** The skin in this area is thin and rich in nerve endings, making it a core region for the ABVN.
- **The posterior wall of the external auditory canal:** Stimulation of this area may trigger the Arnold cough reflex (due to the connection between the vagus nerve and the laryngeal nerves).
- **The Peri-tragus:** The ABVN supplies the Inner side of the tragus. The ATN of the trigeminal nerve and the GAN of the cervical plexus also supply the skin around the tragus, participating in sensory transmission of this area together.



- ABVN : Auricular Branch of the Vagus Nerve
- ATN : Auriculotemporal nerve
- GAN : Great auricular nerve

Function and physiological regulation of ABVN

1. Sensory Conduction

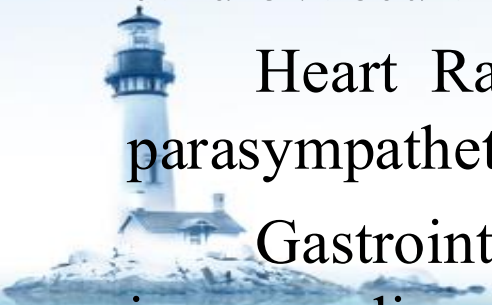
The auricular branch of the vagus nerve transmits tactile and temperature signals from the external auditory canal, concha, and tragus to the nucleus tractus solitarius in the medulla oblongata, and then to the cerebral cortex.

2. Parasympathetic Function

The vagus nerve affects visceral activity indirectly through its auricular branch. When the auricular branch of the vagus nerve is stimulated (e.g., through acupuncture or percutaneous auricular vagus nerve stimulation taVNS), signals are transmitted to the medulla oblongata via the jugular foramen, activating brainstem structures such as the nucleus tractus solitarius and participating in the regulation of cardiovascular, digestive, and other visceral functions.

Heart Rate Regulation: Stimulation of the concha region may activate the parasympathetic effect of the vagus nerve, lowering the heart rate.

Gastrointestinal Motility: Some studies suggest that auricular acupuncture can improve digestive function through the vagus nerve.



Symptoms of ABVN injury

The auricular branch of the vagus nerve (Arnold nerve) is mainly responsible for sensation in the external auditory canal, tragus, concha, and posterior auricle. Damage to this branch mainly results in sensory abnormalities.

1. Decreased sensation/Numbness in the Ear

Numbness in the external auditory canal, behind the ear, and back of the auricle; decreased sensation to touch, hot or cold stimuli.

2. Ear Pain or Abnormal Pain

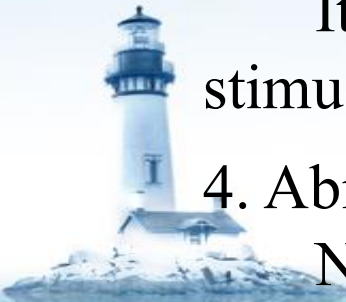
Persistent deep ear pain, stinging or burning pain, which worsens when the ear is touched.

3. Hypersensitivity/Abnormal Sensation

Itching, crawling sensation, or a foreign body sensation in the ear; even slight stimulation causes significant discomfort.

4. Abnormal Cough Reflex

No cough or significantly weakened cough reflex when the ear is stimulated (normal stimulation of the external auditory canal should trigger a reflexive cough).



Testing sites of the auricular branch of the vagus nerve

- The auricular branch of the vagus nerve is mainly distributed in the skin of the concha (cymba conchae, cavum conchae), the inner surface of the tragus, and the posterior wall of the external auditory canal.
- The CPT Goldtrode electrode is placed in the concha for testing.

Human Ear Concha – Two Parts



Neurotron, Inc -

The use of the Neurometer® for evaluating the Vagus Nerve.

Placement of the electrode on the concha of the ear permits direct evaluation of brainstem sensory function via the vagus nerve. This placement prevents the possibility of electrically evoking muscle twitches under the stimulating electrode during the testing.

The second electrode holder is connected to a skin dispersion patch. The self sticking dispersion electrode is typically placed on the face. Because the surface area of this patch electrode is much greater than the stimulating electrode, the current density remains so low that the underlying nerves do not receive adequate stimulus to evoke a response - even at the maximum stimulus output of 10 or 20 mAmps.

The distribution of the auricular branch of the vagus nerve to the external ear (shaded area, extrapolated from Peuker and Filler]). C, concha; T, tragus; CyC, cyma concha.

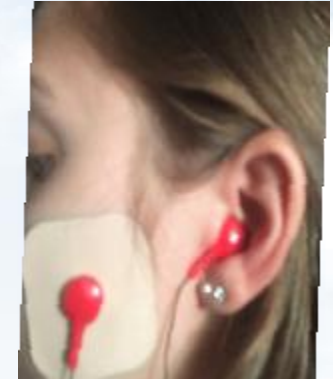


Figure 2 - Goldtrode on Concha

There are two testing options:

a) Have the patient press their finger over the red electrode holder to maintain contact with the concha surface.

Or

b) Place softape over the stimulating electrode.



Figure 3 - Softape applied over Goldtrode

Clinical significance of testing the ABVN (1)

1. Assisting in Localization of Neurological Lesions

- Any discomfort in the ear (such as decreased sensation/numbness/paresthesia, ear pain, or abnormal cough reflex), especially if accompanied by abnormal ABVN testing (e.g., decreased sensation), may indicate that these symptoms are due to localized damage to the auricular branch itself or its terminals.
- Symptoms of vagal nerve dysfunction, such as hoarseness, dysphagia, or tachycardia, coupled with abnormal auricular branch testing, suggest a lesion proximal to the auricular branch from which the vagus nerve originates (e.g., at the jugular foramen).
- Cough response to stimulation of the ear canal (e.g., ear picking) (auricular-cardiac reflex or Arnold reflex) is a characteristic symptom. The absence of this reflex may indicate lesions in the vagal nucleus or trunk.



Clinical significance of testing the ABVN (2)

2. Differential Diagnosis of Auricular Neuralgia

- Ear pain may be caused by the trigeminal nerve, glossopharyngeal nerve, facial nerve or auricular branch of the vagus nerve. Abnormal results detected on the auricular branch of the vagus nerve on CPT testing but normal results detected on the trigeminal nerve and other nerves can aid in the diagnosis of "auricular neuralgia."

* When the motor or parasympathetic function of the vagus nerve is severely impaired (such as in cardiac arrest or severe dysphagia), the sensory function of the auricular branch of the vagus nerve may be completely normal, because the lesion may only affect the vagus nerve fiber bundle that innervates the viscera.

