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# Macrostructure of the cranial cervical ganglionar complex and distal vagal ganglion during post natal development in dogs

# Macroestrutura do complexo ganglionar cervical cranial e gânglio distal do vago de cães durante o desenvolvimento pós natal

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## Summary

Twelve specimens of head and neck of the domestic dog (*Canis familiaris*) were dissected to study the situation, arrangements and branches of the distal vagal ganglion and the cranial cervical ganglion. The ganglions showed a fusiforme shape, covered by the M. digastricus. The main branches of the cranial cervical ganglion included the internal carotid and external carotid branches and of distal vagal ganglion included the cranial laryngeal nerve. This study showed that the cranial cervical ganglion and the distal vagal ganglion in dogs are well developed structure. There were no obvious anatomical differences between the same ganglions presented in both antimeres.

**Key-words**
Cranial cervical ganglion.
Distal vagal ganglion.
Nodose ganglion.
Sympathetic trunk.
Nervous system.

## Introduction

The autonomic nervous system in the rat and other mammals consist in a vast arrange of nerves and ganglions, connected to the central nervous system on one side and to the visceras on the other side. Many ganglions can be easily observed as protrusions or thickness of nervous chain or arrange of various nerves. Some of these ganglions are connected in chains, plexus or intramurais. Two ganglions are described on the neck region, the superior cervical ganglion (SCG) or cranial cervical ganglion (CCG), in veterinarian, and the caudal cervical ganglion or stellatae ganglion, sometimes the middle cervical ganglion can be present. CCG is classified as paravertebral ganglion[1].

CCG provides sympathetic input to the head and neck. In rats, CGC is an attractive model because it is easily located and subjected to experimental manipulation and it is being used as a model for the investigation of neurobiological problems[2].

The gross anatomy of the cranial cervical ganglion were reported by Sheng, Ling e Ming[3] demonstrating that the cranial cervical ganglion is a very well developed strucuture, disposed ventrally the M. sternomastoideus and covered by the mandibular gland. Main branches leaving the ganglion were related as intenal carotid nerve and external carotid nerve.

The composition of the vagus nerve of the cat was studied by Mei, Condamin e Boyer[4]. The number and caliber of myelinated and non-myelinated fibers of entire and sensory vagal nerves of cats were studied by light and electron microscopy. The results showed that the ratio of myelinated to non-myelinated fibers was on the average 1:4 for the total vagi and 1:8 for the sensory vagal component.

Vagus nerve is essentially visceral control. The vagal rootlets leave the brain along the dorsolateral sulcus of the medula oblongata in series with the rootlets of cranial nerves IX and XI. The vagus has two sensory ganglia that a few milimeters distal to the origin of the vagus is located the small proximal vagal ganglion (jugular ganglion – *ganglion proximale n. vagi*). It contains unipolar sensory-type neurons whose dendrites are distributed with the auicular branch (*r. auricularis*) of the vagus. The pharyngeal branch (*r. pharingeus*) of the vagus is given off between the proximal and distal ganlglion (nodose ganglion – *ganglion distale n. vagi*). The latter ganglion is also composed mainly of unipolar sensory-type neurons that have their peripheral distribution in the viscera[5].

Studies about the distribution and origin of the nerve fibers in the rat temporomandibular joint capsule through the injection of the retrograde tracer True Blue into temporo mandibular joint. The injection resulted in the appearence of numerous labelled cell bodies in the trigeminal and SCG and moderate numbers in the nodose, otic, sphenopalatine, stellate and dorsal root ganglions at levels C2-C5. This study revealed that the nodose ganglia contributes with the innervation and so the superior cervical ganglion and the staellate[6].

Vanhatalo and Soinila[7] developed study about the innervation to the anterior lobe of the pituitary gland searching for evidence for nodose ganglion as the source of innervation. Applying nueroanatomical tracings on the pituitary gland, their findings suggested that the nodose ganglion neurons innervate the pituitary anterior lobe, while neither hypothalamus nor sympathetic cervical ganglion may be a source of this innervation.

Due of lack of information regarding these autonomic and vagal ganglions in large mammals, the aim of the present study was to describe the location, arrangement and distrtibution of the cranial cervical ganglion and distal vagal ganglion to provide morphological basis on further investiation foccusing on the comparative neuroanatomy, neurophysiology and neurology of the canine autonomic nervous system.

## Material and Method

For this study, 12 mongrel male dogs obtained from Faculdade de Medicina Veterinária da Fundação de Ensino Octávio Bastos, Faculdade de Medicina Veterinária e Zootecnia da Universidade São Paulo and Centro de Controle de Zoonoses da Prefeitura Municipal de São Paulo, and divided into two groups.

Group 1: six animals, one month old aged.

Group 2: six animals, 36-60 months old aged.

The animals were submitted to chemical euthanasia. Preanaesthesic drugs were used to prepare the patient for induction and contribute to maintenance. To induce the sedation, we applied an anticholinergic drug – Acepromazine 0.20% that is a potent neuroleptic agent with relative low toxicity. The following dose were used for intravenous injection, 0.2mg/kg. For induction and maintenance of the anaesthesia was used thiopental sodium that it is a thiobarbiturate at 6.0 mg/kg. Afterwards the animals were euthanasied using an overdose of sodium thiopental at 12.0 mg/kg observing the initial toxic effect, producing depression of the respiratory centres, affecting rate and amplitude of cardiac frequency until death.

#### Gross anatomic study

Group 1: 6 animals – 12 distal vagal ganglions and 12 cranial cervical ganglions.

Group 2: 6 animals – 12 distal vagal ganglions and 12 cranial cervical ganglions.

After the euthanasia, the animals were perfused within 24 hours by infusion with 30.00% aqueous formol solution through the femoral artery. The cranial cervical ganglion and distal vagal ganglion and theirs branches were approached laterally on each side of the head by gross anatomical dissection.

After a superficial incision of the skin, superficially, it was identified masseter, parotidoauricularis and sternomastoideus muscles, external jugular, maxilar and facial veins, parotid and mandibular salivary glands, parotid duct and mandibular lymph nodes.

Removing the skin and the superficial structures, it was identified digastricus, styloyoideus, thyropharyngeus, thyrohyoideus, sternohyoideus and sternothyreoideus muscles.

A deep dissection of the region revealed the carotid sheath with the vagosympathetic trunk, common carotid artery and internal jugular vein. The carotid sheath was followed until the basis of the head and it was identified the occipital artery, the bifurcation of the common carotid artery into internal and external carotid arteries, the bifurcation of the vagosympathetic trunk into vagus nerve and sympathetic trunk.

Afterwards, the distal vagal ganglion and the cranial cervical ganglion were approached. Hydrogen peroxide solution and alcoholic acetic acid solution were applied on the region in order to expose and individualize the structures. Microdissection of the region was carried out in order to obtain better results using LEICA M651 surgical microscope.

## Results

The ganglia were located at the most cranial portion of the neck. Following the cervical vagosympathetic trunk after its bifurcation, the cranial cervical ganglion and the distal vagal ganglion were located close to the M. digastricus, that it was removed for more clear observation of the ganglia. Concerning about vessels and arteries properly, the cranial cervical ganglion was placed closely to the internal carotid artery and the same relationship was observed of vagal distal ganglion and occipital artery.

Cervical ganglion was situated cranially to the distal vagal ganglion. Both were covered by a capsule that showed a complex arrangement, mainly, between the cranial portion of the distal vagal ganglion and the caudal portion of the cranial cervical gagnlion.

The ganglia presented as a well developed structure, fusiforme shape, ranging 4–6mm length (long axis), 2–2,50mm width (short axis) for distal vagal ganglion and 4–6mm length (long axis), 2–3mm width (short axis) for

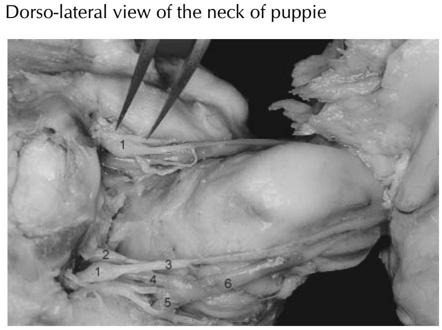
**Figure 1**
Left Lateral View of the cervical region of adult dog


1. M. Masseter (superficial); 2. and 2´ M. Digastricus (partially removed); 3. Hipoglossal nerve; 4. Distal vagal ganglion; 5. Vagal sympathetic trunk; 6. Common carotid artery; 7. M. Sternohioydeus; 8. Trachea. Magnification: 3.3x

**Figure 2**
Dorsal View of the cervical region of adult dog


1. Distal vagal ganglion; 2. Cranial cervical ganglion; 3. M. Thyropahryngeus Magnification: 3.5x

**Figure 3**
Dorso-lateral view of the neck of puppie




1. Distal vagal gagnlion; 2. Cranial cervical ganglion; 4. Internal carotid artery; 5. External carotid artery; 6. Common carotid artery
Magnifying: 3,4 x.

cranial cervical ganglion.

External carotid branches running along and to the external carotid artery were seen leaving the caudal portion of the cranial cervical ganglion. It was also determinated, arising from cranial portion of the cranial cervical ganglion, internal carotid branches to the internal carotid artery.

Branches leaving the cranial pole of the distal vagal ganglion were seen, its irrigation target could not be examined. From the ventral region of the distal vagal ganglion arose the cranial laryngeal nerve running caudally and passing between the M. ceratopharyngeus, M. thyropharyngeus and M. thyrohyoideus.

## Discussion and Conclusion

The shape of the ganglions, the cranial cervical ganglion and the distal vagal ganglion presented fusiforme shapeness, agreeded with the description of other authors Luebke and Wright[2], Stromberg[5] e Gabella[1]. The ganglions were located at the cranial region of the neck covered by the M. digasytricus and related to the hipoglossal nerve as described by Stromberg[5].

The main branches of the cranial cervical ganglion included the internal carotid and external carotid branches and of distal vagal ganglion included the cranial laryngeal nerve as the results showed by Sheng, Ling e Ming[3].

This study showed that the cranial cervical ganglion and the distal vagal ganglion in dogs are well developed structure. There were no obvious anatomical differences between the same ganglions presented in both antimeres.

## Resumo

Doze cães domésticos (*Canis familiaris*) foram dissecados para o estudo da situação, arranjo e ramificação nervosa do gânglio distal do nervo vago e gânglio cervical cranial. Os gânglios apresentaram-se fusiformes e recobertos pelo músuculo digástrico. Os principais ramos do gânglio cervical cranial observados foram os ramos para a artéria carótida externa e artéria carótida interna. Destacou-se o nervo laringeal cranial como ramo do gânglio distal do nervo vago. O estudo revelou gânglio cervical cranial e o gânglio distal do vago eram estruturas bem desenvolvidas e não encontrou-se diferenças anatômicas entre os gânglios observados em ambos antímeros.

**Palavras-chave**
Gânglio cervical cranial.
Gânglio distal do nervo vago.
Gânglio nodoso.
Tronco simpático.
Sistema nervoso.

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