Medico Research Chronicles

ISSN No. 2394-3971

Case Study

GANGLION CELLS IN PORTION OF LINGUAL NERVE SUSPENDING SUBMANDIBULAR GANGLION – A CASE REPORT

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Submitted on: July 2017
Accepted on: July 2017
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Abstract:
Haematoxylin and Eosin sections of a submandibular ganglion and its two roots suspended by the lingual nerve, with a portion of the submandibular gland were prepared from tissue obtained from an adult male cadaver during routine dissection. Ganglion cells were present in the submandibular ganglion, in the hilum of the submandibular gland, and in the epineurium, perineurium and within the fascicles of lingual nerve in longitudinal sections. Most parasympathetic ganglia of the head and neck are cell bodies of neurons clumped together, to form tiny ganglia scattered in supporting tissue. The ganglion cells in the nerve were thought to be derived from myelencephalic neural crest cells arrested in their descent along the lingual nerve. A review of recent literature reveals that they are derived from Schwann cell precursors that migrate along nerves.

Keywords: submandibular gland, gangliogenesis, parasympathetic ganglion

Introduction:

A ganglion is a collection of neurons, their processes and supporting cells outside the central nervous system. [1] In the case of cranial parasympathetic ganglia, ganglion cells are very often scattered in the surrounding tissue and may not be present as a recognizable ganglion. [2] Under light microscopy autonomic ganglia appear as large relay stations with large multipolar neurons surrounded by afferent and efferent fibers and non-neural cells. The ganglion cell has a characteristic owl's eye appearance with satellite cells forming a partial capsule around it. This case report shares an incidental finding of ganglion cells found in the trunk of the lingual nerve in the segment that suspends the submandibular ganglion of an adult male cadaver (fig 1). A reference to standard textbooks of anatomy and relevant literature on the subject does not reveal ganglion cells in this location.

Case Report:

H&E sections of the submandibular ganglion of an adult male cadaver were prepared with the part of lingual nerve suspending it and a part of the submandibular gland. Ganglion cells were found in the trunk of the lingual nerve (fig 2), its epineurium (fig 3), in the hilum of the gland (fig 4) and the submandibular ganglion proper (fig 5).

Discussion:

Ganglion cells have been reported in the course of oculomotor and internal laryngeal nerve. [3,4] A ganglion cell cluster has been reported along the glossopharyngeal nerve near the human palatine tonsil by Oda K et al in 2013. [5] Presence of nerve cell bodies in the lingual nerve in the third molar area has been reported by Smith EE in 1989. [6] Nerve cell bodies were found within the structure of 40 of the 44 individual nerves (90.91%). There were two patterns of organization of the nerve cell bodies: isolated nerve cell bodies and ganglion-like clusters of nerve cell bodies. Due to their proximity to the submandibular ganglion, it was inferred that these cell bodies were parasympathetic in function. In our case we observed ganglion like clusters of nerve cell bodies in the trunk of the lingual nerve in various sections throughout the segment under consideration. Whereas isolated nerve cell bodies were found in the epineurium of the same segment. The typical appearance of ganglion cell, large cell body with eccentric nucleus and prominent nucleolus (owl's eye appearance); with satellite cells forming a partial capsule around it is characteristic of an autonomic ganglion cell.

The ganglion-like clusters reported by us, being even closer to the submandibular ganglion than the cells observed by Smith, it may be inferred that they are parasympathetic in function. The submandibular ganglion receives sympathetic post-ganglionic fibers from the superior cervical ganglion that traverse it without synapsing. It also receives parasympathetic pre-ganglionic fibers from the superior salivatory nucleus. Some of these fibers could be traversing and /or synapsing with the ganglion cells in this portion of the lingual nerve.

Fibers passing through anterior root of submandibular ganglion carry secreto-motor fibers to the sublingual and anterior lingual glands. The post- ganglionic fibers of ganglion cells observed by us in trunk of lingual nerve may be serving the same function; thereby supplementing the function of the submandibular ganglion. This could have clinical significance in surgeries of the submandibular region where the submandibular ganglion, gland and surrounding tissue may be sacrificed with preservation of lingual nerve.

The cell bodies of neurons in parasympathetic ganglia may form well organized ganglia of moderate size (otic ganglion). More commonly, a few cell bodies are clumped together to form ganglia scattered in supporting tissue. [2] By that corollary, the ganglion cells found in the perineurium & endoneurium of lingual nerve, and hilum of the gland, are the scattered component of the submandibular ganglion.

The submandibular ganglion is derived from myelencephalic neural crest and may receive contribution from nucleus of facial nerve (superior salivatory nucleus) according to Gray's Anatomy 40th edition. [3] The ganglion cells found in the trunk of the lingual nerve may be cells migrating from Superior Salivatory Nucleus, or neural crest cells migrating along the lingual nerve.

Dyachuk et al 2014; Espinosa-Medina et al, 2014 stated that parasympathetic ganglia are derived from peripheral Schwann cell precursors that migrate along nerves to their target tissue to form both the glia and neurons of the ganglia. [7,8] Thus, the parasympathetic ganglion (PSG) in the submandibular gland (SMG) arises from Schwann cell precursors that migrate along the chorda tympani and differentiate into βIII-tubulin-expressing neurons (TUBB3+).

The next critical step in parasympathetic gangliogenesis occurs when the PSG neurons coalesce around the primary duct to form the ganglion and establish communication with the developing epithelium. [9] Therefore, parasympathetic innervations are critical for SMG development and regeneration.

The process of parasympathetic gangliogenesis, is achieved by activation of the wingless-related integration site (Wnt) signaling pathway which is done by keratin 5 –positive (K5+) epithelial progenitors in the SMG. [9] Suppression of the fibroblast growth factor (FGF) signaling pathway is required for SMG parasympathetic gangliogenesis.[9]

Key intracellular modulators of FGF signaling are Sprouty (Spry) proteins, which act as negative-feedback antagonists. [10,11,12] Therefore, epithelial Spry 1/2 are required for SMG parasympathetic gangliogenesis.

Thus, our finding ganglion cells in trunk of lingual nerve is explained by the recent theory of parasympathetic gangliogenesis from Schwann cell precursors migrating along the chorda tympanii component of lingual nerve. These neurons found in the nerve probably failed to coalesce to form a macroscopically visible ganglion due to failure of activation of Wnt signaling pathway by K5+ epithelial progenitors in the developing submandibular gland. Since the neuro-epithelial interaction is of essence for both development of parasympathetic ganglion and secretion by the gland, the functional significance of the ganglion cells in the trunk of the nerve is questionable. Performing an immuno-histochemical analysis of the sections of lingual nerve for tyrosine hydroxylase and nitric oxide synthase may throw light on the functional significance of occurrence of these cells in the trunk of lingual nerve. [13]

Abbreviations Used:

PSG- parasympathetic ganglion; SMG submandibular gland; βIII tubulin-expressing neurons- TUBB3+; wingless-related integration site –Wnt; keratin 5 –positive K5+; fibroblast growth factor FGF; Sprouty –Spry

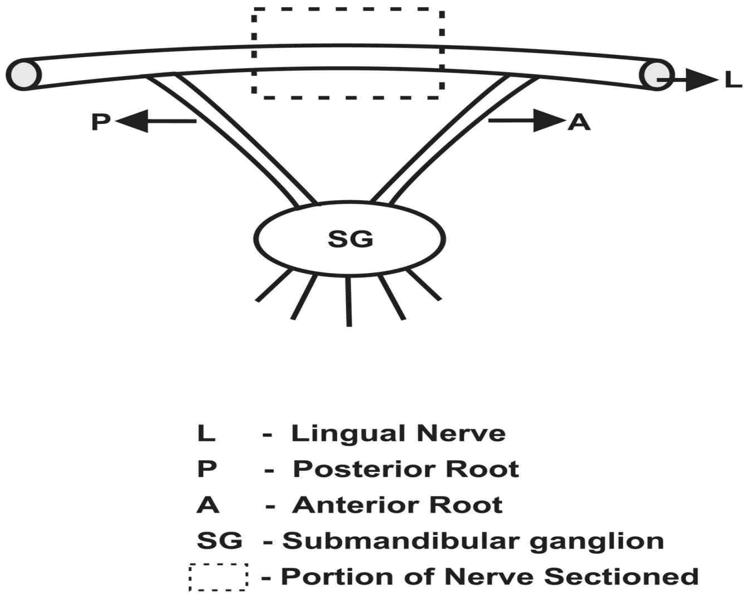

Fig 1: Diagram showing portion of the lingual nerve sectioned

Fig 2a: Ganglion cells in trunk of lingual nerve (40xmagnification encircled in black)

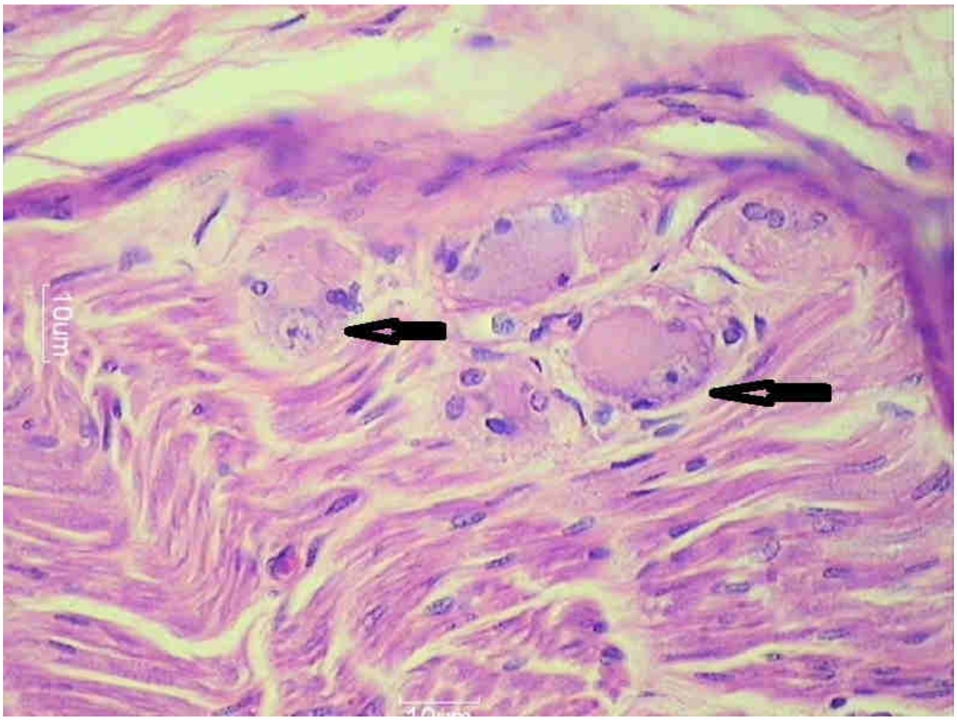

Fig 2b: Ganglion cells in trunk of lingual nerve (400xmagnification black arrows)

Fig 3a: Ganglion cells in the epineurium (40xmagnification encircled in black)

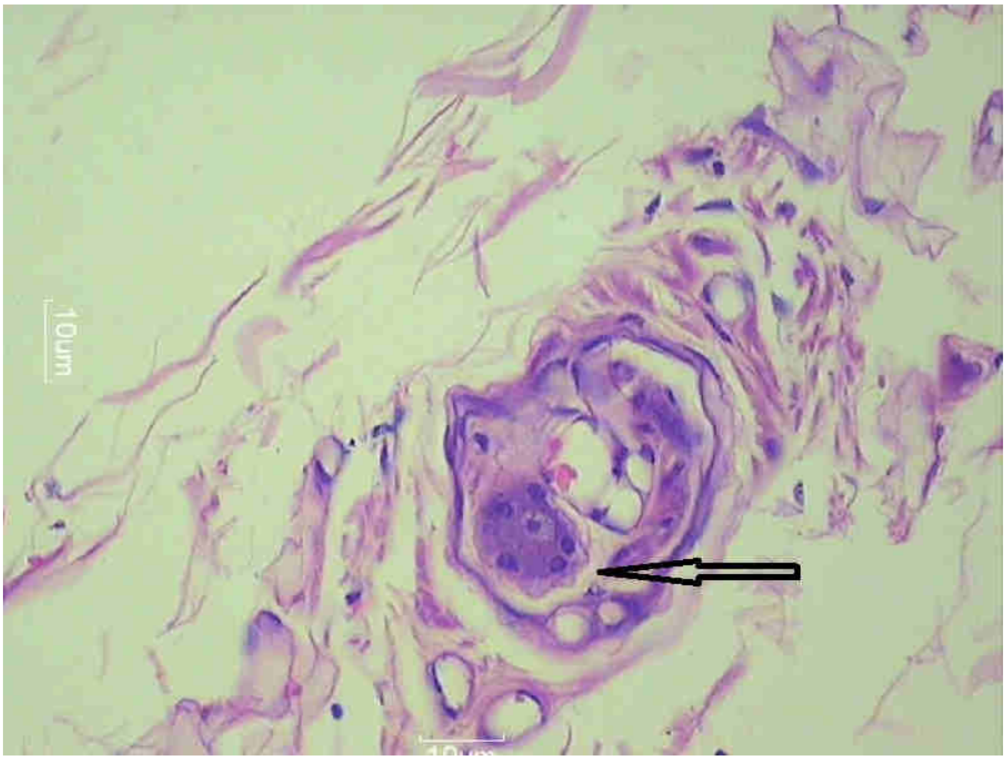

Fig 3b: Ganglion cells in the epineurium (400xmagnification black arrow)

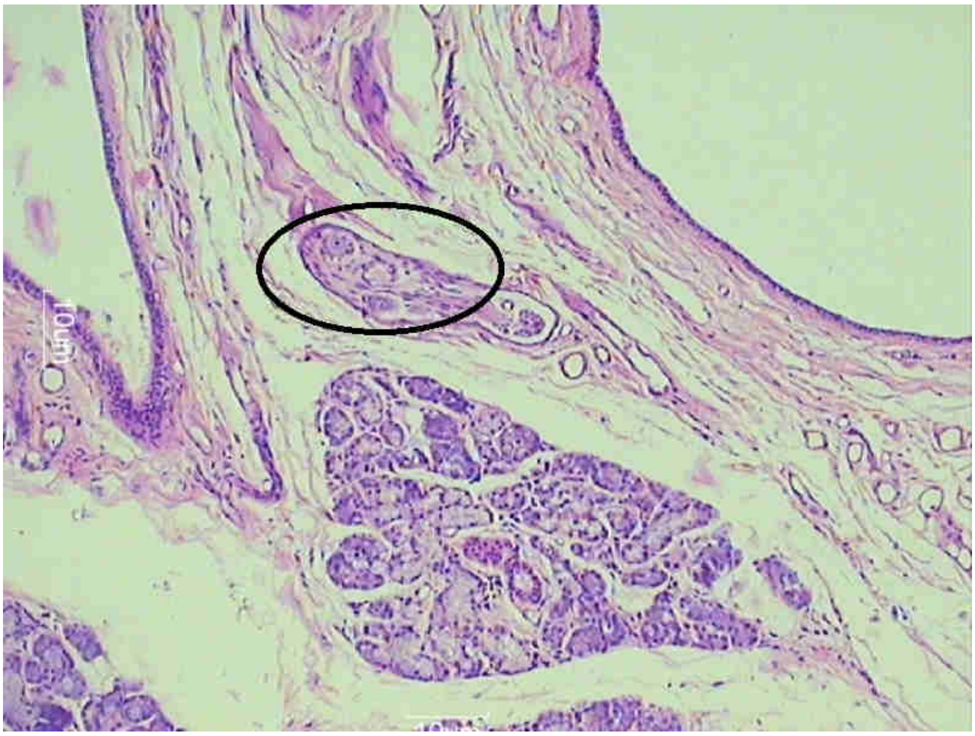

Fig 4a: Ganglion cells in hilum of gland (40× magnification encircled in black)

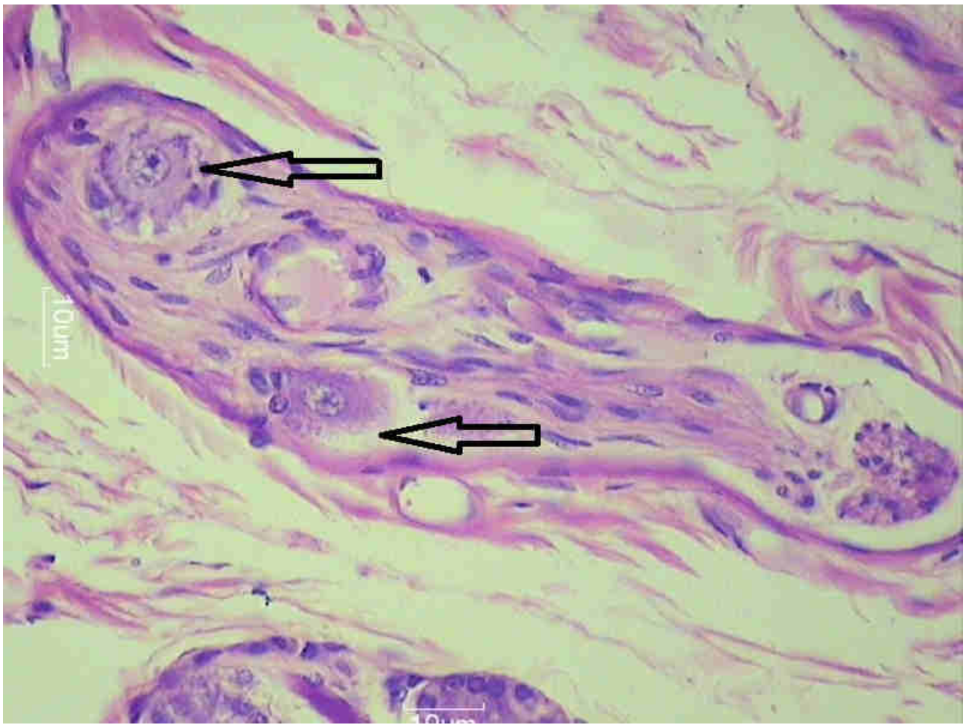

Fig 4b: Ganglion cells in hilum of gland (400× magnification black arrows)

Fig 5: Ganglion cells in submandibular gland proper (400× magnification)

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