European Archives of Oto-Rhino-Laryngology (2019) 276:2105–2108
https://doi.org/10.1007/s00405-019-05436-2

SHORT COMMUNICATION

Report of a non-looped variant of ansa cervicalis with omohyoid innervation from accessory nerve branch and omohyoid attachment to mastoid process

James W. H. Sonne[1]

Received: 27 March 2019 / Accepted: 16 April 2019 / Published online: 26 April 2019

Abstract

Introduction A variant of the innervation of the infrahyoid neck musculature is reported in which the typical looped ansa cervicalis structure is absent. In this variant, the infrahyoid muscles (sternohyoid, sternothyroid omohyoid and thyrohyoid) were innervated by a presumptive superior root of "ansa cervicalis" traveling with vagus nerve (CN X) and not branching from hypoglossal nerve (CN XII). The omohyoid muscle, typically innervated by the inferior root of ansa cervicalis, is instead innervated by nerve fibers branching from the accessory nerve (CN XI). This formation created a non-looping variant of ansa cervicalis. Furthermore, the omohyoid muscle did not attach to the hyoid bone but instead attached to the mastoid process of the temporal bone by merging its fibers superiorly and posteriorly with the clavicular portion of the sternocleidomastoid muscle, creating a "sternocleidoomomastoid" muscle innervated by a branch of accessory nerve.

Materials and methods This variation was found in one black male cadaver from a cohort of 25 male and female cadavers.

Results Only one variation of ansa cervicalis was observed.

Conclusions As neck dissections and surgical procedures of this region are performed for a variety of conditions—including coronary artery bypass grafting and metastatic neck disease—variations of this type are of broad clinical surgical importance.

Keywords Ansa cervicalis · Variation · Descendens hypoglossal · Neck surgery

Introduction

Ansa cervicalis is a looped nerve structure in the carotid triangle of the anterior neck, closely associated with the carotid sheath in the region of the bifurcation of the common carotid artery. This nerve loop is responsible for the innervation of the infrahyoid muscles (sternohyoid, sternothyroid, thyrohyoid, and omohyoid). The ansa cervicalis is formed by two "roots". The superior root (sometimes called descendens hypoglossi) is derived from the anterior ramus of the C1 spinal nerve. Typically, these C1 fibers briefly join with the hypoglossal nerve (CN XII) to travel anteriorly in the submandibular triangle of the suprahyoid neck region. These C1 fibers will then leave the course of CN XII to descend as the superior root of ansa cervicalis. The inferior root of ansa cervicalis has its origins from C2 to C3 anterior spinal nerve rami. These fibers travel between the anterior and middle scalenes to give off branches that form the inferior root, which continue to travel anteriorly to join the superior root of ansa cervicalis, thereby forming the "loop" after which "ansa" cervicalis is named. Accessory nerve (CN XI), is also located in this same region, along with phrenic nerve. The fibers of CN XI arise from the C1 to approximately C6 spinal grey matter and take their own circuitous route to reach the neck and innervate the trapezius and sternocleidomastoid muscles. Also of note, trapezius and sternocleidomastoid have additional sensory innervation directly from the C2/C3 primary rami. Phrenic nerve, likewise, has its origins in the C3–C5 spinal grey matter and supplies motor innervation to the muscular portion of the thoracic diaphragm.

Surgical procedures are commonly performed in this region of the neck, including the use of the internal thoracic artery during coronary artery bypass grafting, the removal of metastatic neck cancers such as in the lymph nodes [8], or even platysmaplasty procedures to alter the appearance

✉ James W. H. Sonne
james.sonne@ucf.edu

[1] Health and Public Affairs I, School of Kinesiology and Physical Therapy, University of Central Florida, Office 256, 12805 Pegasus Dr., Orlando, FL 32816-2205, USA

of the superficial neck. Grafts of the ansa cervicalis are also used for reinnervation of the vocal cords after unilateral vocal cord paralysis due to peripheral nerve lesion [9]. Variations of the ansa cervicalis or other structures may pose consequences for the course and outcome of such surgical procedures.

During routine dissection of 25 cadavers (12 female, 13 male), 1 variation of the ansa cervicalis structure was identified in one black male. The related structures, including the cervical plexus, hypoglossal nerve, accessory nerve, and phrenic nerve were clearly identified and their nerve paths confirmed. Historically, the Caliot–Dumont classification patterns have included seven types of ansa cervicalis variations [3, 6]. A survey of the literature indexed on PubMed identified 16 articles describing variations of ansa cervicalis or its pattern of muscular innervation, but none matching this description.

Methods

Routine dissection of 25 cadavers (12 female, 13 male) was performed between 2016 and 2019 at the University of Central Florida within the School of Kinesiology and Physical Therapy. The structures of the neck were fully dissected in stages and structures identified, including proximal and related muscular, neural, and vascular structures. In addition, a survey of literature indexed on PubMed was used to identify the novelty of the finding by searching for keywords "ansa" "cervicalis" "variation".

Results

During routine dissection of one elderly black male cadaver, notable variations of the neck musculature and innervation pattern were observed. The omohyoid muscle normally attaches to the superior border of the scapula and travels anteriorly and superiorly to attach to the hyoid bone. However, in this case the omohyoid muscle, of typical size, instead merged with clavicular portion of the sternocleidomastoid muscle to join in its attachment to the mastoid process of the temporal bone, creating a three-headed "sternocleidoomomastoid" muscle. The "omo-" portion of this muscle received a dedicated innervation branching from the accessory nerve (CN XI) instead of the typical pattern of innervation from the inferior root of ansa cervicalis. Upon dissection of the muscular and carotid triangles of the anterior neck, it was observed that the typical looping ansa cervicalis nerve pattern was absent, and instead the infrahyoid muscles were innervated from a non-looping nerve traveling with and branching from the vagus nerve (CN X) without the typical association with the hypoglossal nerve (CN XII) (see Fig. 1). Upon surveying the literature indexed on PubMed, 16 articles noted variations of the ansa cervicalis nerve loop with dates ranging from 2000 to 2017 but none described the pattern observed here. One described a variant in which the inferior root of ansa cervicalis travels with the accessory nerve [5] while several identify a vagal association with ansa cervicalis [7, 4], but none that originated from both while omitting the characteristic loop. The anterior primary rami of C2, C3, and C4 spinal nerves, along with the brachial plexus, were clearly identifiable between the anterior and middle scalene muscles, and no branches were extending from them to the infrahyoid muscles. The typical pattern of the cutaneous sensory nerves of the cervical region was all identified at Erb's point posterior to the sternocleidomastoid. Carotid and jugular perfusion prevented the identification of the nerve pattern on the contralateral side, but intact structures including the hypoglossal and accessory nerves and omohyoid structure strongly suggested the same pattern was likely bilaterally (Fig. 2).

Discussion

The description of the ansa cervicalis has persisted since 1733 when Jacques-Bénigne Winslow first described the entire loop in his work "An anatomical exposition of the structure of the human body", even though significant numbers of variations and patterns have been identified and the classical description may only make up as little as 38% of cases [6, 1]. Described in this report is a variant in which the typical looped structure of ansa cervicalis is not present, and the inferior root is seemingly replaced by a branch from accessory nerve (CN XI) while the superior root originates with vagus nerve (CN X). This branch innervates an omohyoid muscle with a non-typical attachment to the mastoid process of the temporal bone, instead of the typical attachment to the hyoid bone, by merging with the clavicular muscle fibers of sternocleidomastoid. Previously published articles surveyed variation types in ansa cervicalis but do not appear to mention this rather unusual anatomy [6, 1].

There may be an embryological justification for this unusual arrangement, as all of the nerves involved originate from nuclei of the cervical spinal cord. Typically, they will follow different paths to their target structures as growth factors guide this process, but it is conceivable that this developmental process may ultimately result in different patterns in the developed human depending on variables in the embryological environment or genetic factors. The infrahyoid strap muscles, including omohyoid, are innervated by anterior grey matter from C1 to C3, while the accessory nerve (CN XI) has its origins along the C1 to approximately C6 spinal cord. Other variations of ansa cervicalis in the literature indicate that fibers may travel with vagus nerve (CN

Fig. 1 In this anatomical variant the superior root of ansa cervicalis is clearly present and traveling with CN X, but is not joined by an inferior root which is traveling with CN XI, thus no looped structure is formed. Omohyoid (reflected) is visible joining sternocleidomastoid (reflected) to attach to the mastoid process of the temporal bone

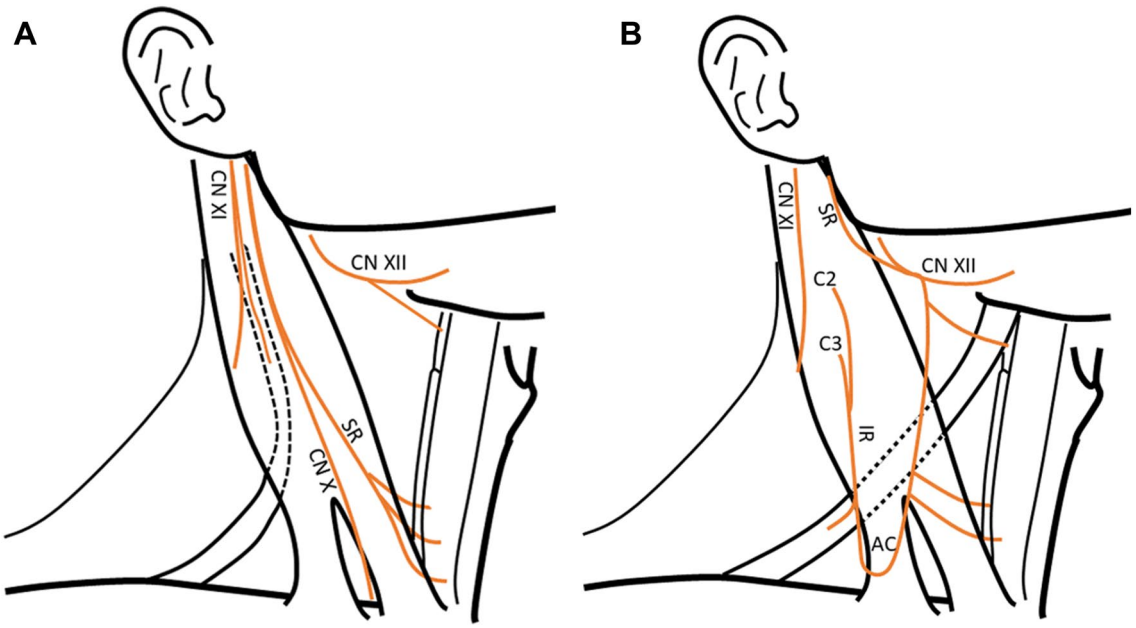

Fig. 2 **a** The anatomical variant observed in this case. **b** The typical anatomy of the ansa cervicalis and related structures. *SR* Superior root of ansa cervicalis, *IR* Inferior root of ansa cervicalis, *AC* ansa cervicalis

X) [7] or phrenic nerve [1]. The nucleus ambiguus of vagus nerve and the phrenic nucleus are both motor nuclei that reside at least partly within the cervical spinal cord [10]. For this reason, it may be possible that the typical innervation of omohyoid, from C3 anterior horn grey matter, could travel with the developing accessory, phrenic, or vagus nerves to

reach its final target proximal to these nerves. Likewise, other variations of ansa cervicalis may develop as a result of this same embryological process. Indeed, a nerve variant in which sternocleidomastoid was found to be innervated by a branch from hypoglossal nerve (CN XII) has even been identified in 2.5% in one study [2].

A number of surgical operations are performed in this region of the neck, and surgeons in particular, but also support staff, rehabilitation specialists, and other healthcare professionals should be aware of the possibility for variations in these structures as such variations will affect the course and outcome of a procedure as well as the potential for functional recovery. As such, it is important that the literature contain descriptions of these identified variations.

Author contributions Sonne performed all work described in this manuscript, including the dissections and structure identification, research, writing, photography, and illustrations.

Compliance with ethical standards

Conflict of interest Sonne reports no conflicts of interest.

References

1. Banneheka S (2008) Morphological study of the ansa cervicalis and the phrenic nerve. Anat Sci Int 83:31–44. https://doi.org/10.1111/j.1447-073X.2007.00201.x
2. Brennan PA, Alam P, Ammar M, Tsiroyannis C, Zagkou E, Standring S (2017) Sternocleidomastoid innervation from an aberrant nerve arising from the hypoglossal nerve: a prospective study of 160 neck dissections. Surg Radiol Anat 39:205–209. https://doi.org/10.1007/s00276-016-1723-9
3. Caliot P, Dumont D, Bousquet V, Midy D (1986) A note on the anastomoses between the hypoglossal nerve and the cervical plexus. Surg Radiol Anat 8:75–79
4. Jelev L (2013) Some unusual types of formation of the ansa cervicalis in humans and proposal of a new morphological classification. Clin Anat 26:961–965. https://doi.org/10.1002/ca.22265
5. Khaki AA, Shokouhi G, Shoja MM, Farahani RM, Zarrintan S, Khaki A, Montazam H, Tanoomand A, Tubbs RS (2006) Ansa cervicalis as a variant of spinal accessory nerve plexus: a case report. Clin Anat 19:540–543. https://doi.org/10.1002/ca.20299
6. Loukas M, Thorsell A, Tubbs RS, Kapos T, Louis RG Jr, Vulis M, Hage R, Jordan R (2007) The ansa cervicalis revisited. Folia Morphol (Warsz) 66:120–125
7. Manjunath KY (2000) Vagal origin of the ANSA cervicalis nerve—report of two cases. Indian J Otolaryngol Head Neck Surg 52:257–258. https://doi.org/10.1007/BF03006195
8. Natsugoe S, Okumura H, Matsumoto M, Ishigami S, Owaki T, Nakano S, Aikou T (2005) Reconstruction of recurrent laryngeal nerve with involvement by metastatic node in esophageal cancer. Ann Thorac Surg 79:1886–1889. https://doi.org/10.1016/j.athoracsur.2004.11.055
9. Smith ME (2012) Pediatric ansa cervicalis to recurrent laryngeal nerve anastomosis. Adv Otorhinolaryngol 73:80–85. https://doi.org/10.1159/000334443
10. Sonne J, Lopez-Ojeda W (2018) Neuroanatomy, cranial nerve. StatPearls Publishing, Treasure Island, FL