Unusual morphological pattern and distribution of the ansa cervicalis: a case report

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Abstract
Ansae cervicalis present great anatomic variability regarding its origin and formation, the number of its roots and its distribution, as well. In the current case, we report an aberrancy in the form and distribution of ansa cervicalis branches to the infrahyoid muscles and the sternocleidomastoid muscle, which is unique, since, to the best of our knowledge, a similar case has not been recorded in the literature. During regular dissection, we detected that the ansa cervicalis’ loop, which was formed underneath the superior belly of the omohyoid muscle, provided a branch for the sternothyroid muscle, from which two recurrent rami were arisen. These two rami joined together forming an unusual triangular nerve formation. The neural trunk formed by the union of the aforementioned two rami perforated the inferior belly of the omohyoid muscle and afterwards was directed towards the ipsilateral sternocleidomastoid muscle. The awareness of such an unusual variability to the surgeons of the head and neck region would be of great importance, since it is crucial not to damage the ansa cervicalis or its branches in order to prevent any possible phonation disorders. Additionally, ansa cervicalis is proved to be extremely useful in the re-innervation of the larynx following paralysis of the recurrent laryngeal nerve.

Keywords: ansa cervicalis, innervation, sternocleidomastoid muscle, variation.

Introduction
Multiple variations have been reported regarding the macroscopic anatomy of the ansa cervicalis (AC), otherwise known as ansa hypoglossi. AC is derived from two or more of the first four cervical (C) ventral rami, with the combination of C1–C3 ventral rami being the most frequent pattern, thus 87.5% [1]. The most usual aberrancies concern AC’s origin and formation, number of its roots and its distribution. In the current literature can be traced some cases of the AC with abnormal origin of its roots and its distribution. In the current case, we report an aberrancy in the form and distribution of ansa cervicalis’ branches to the infrahyoid muscles and the sternocleidomastoid muscle, which is unique, since, to the best of our knowledge, a similar case has not been recorded in the literature. During regular dissection, we detected that the ansa cervicalis’ loop, which was formed underneath the superior belly of the omohyoid muscle, provided a branch for the sternothyroid muscle, from which two recurrent rami were arisen. These two rami joined together forming an unusual triangular nerve formation. The neural trunk formed by the union of the aforementioned two rami perforated the inferior belly of the omohyoid muscle and afterwards was directed towards the ipsilateral sternocleidomastoid muscle. The awareness of such an unusual variability to the surgeons of the head and neck region would be of great importance, since it is crucial not to damage the ansa cervicalis or its branches in order to prevent any possible phonation disorders. Additionally, ansa cervicalis is proved to be extremely useful in the re-innervation of the larynx following paralysis of the recurrent laryngeal nerve.

Materials, Methods and Results
During a routine dissection of the neck at the Department of Anatomy, Faculty of Medicine, University of Thessaloniki, Greece, in an 82-year-old female cadaver a variant of the AC was encountered. The cadaver that had been fixed in formalin was provided to our Department for the educational anatomical course. The cause of death was unrelated to the present study. There was no finding showing any medical histories related to the neck region, thus neither evidence of previous surgical procedures nor other abnormalities of the surrounding anatomical structures were detected. After careful dissection of the neck region, the infrahyoid muscles, as well as the AC along with the internal jugular vein and the carotid arteries were identified and prepared meticulously on the right side. Next, we carefully dissected the AC to clarify its precise morphological pattern, as well as its branching pattern. The AC’s loop was formed just underneath the superior belly of omohyoid muscle. After providing three separate branches, one for the superior belly of the omohyoid muscle, one for the thyrohyoid and one for the sternohyoid muscle, the AC’s loop gave off a branch for the sternothyroid muscle, from which two recurrent rami were arisen. These latter rami joined together forming a nerve trunk, which after piercing the inferior belly of the omohyoid muscle, was directed to the ipsilateral sternocleidomastoid muscle, contributing to its innervation. The two rami of the sternothyroid branch formed an unusual triangular nerve formation located...
anterior to the inferior portion of the right internal jugular vein (Figure 1). The precise formation, morphology as well as the AC’s relationship to the neighboring anatomical structures were detected as photographs and schematic drawing during the course of the anatomical dissection.

Figure 1 – (A) The right hemi-neck has been dissected, with the ipsilateral sternocleidomastoid muscle (SM) being retracted. The superior (SR) as well the inferior root (IR) of the ansa cervicalis has been demonstrated forming at the lateral aspect of the internal jugular vein (IJV) a loop. The branches to the omohyoid muscle (OHM), thyrohyoid muscle (THM), sternohyoid muscle (SHM) and sternothyroid muscle (STM) are shown. The sternothyroid branch gives off two rami forming a triangular formation innervating the inferior belly of OHM and SM. 1: Branch to superior belly of OHM, 2: Branch to THM, 3: Branch to SHM, 4: Branch to STM. (B) Schematic representation of (A).

Discussion

The AC lies in front of the internal jugular vein and gives branches to the infrahyoid muscles. It is formed by the union of superior and inferior roots. The superior root or descendens hypoglossi branch leaves the hypoglossal nerve and descends anterior to or in the carotid sheath and contains only C1 fibers. After giving a branch to the superior belly of the omohyoid, it is joined by the inferior root. The inferior root or descendens cervicalis is formed by the union of two branches originating from C2 and C3 respectively. The single nerve so formed spirals around the internal jugular vein and continues forward to join the superior root. From the loop of AC originate branches to the sternohyoid, sternothyroid and the inferior belly of the omohyoid muscle [9, 10] (Figure 2).

Figure 2 – The “classical” ansa cervicalis, as it is formed by the union of its superior (SR) and inferior roots (IR) in front of the internal jugular vein (IJV) along with its branches innervating the infrahyoid muscles. CA: Common carotid artery, HN: Hypoglossal nerve, C2: Second cervical ventral ramus, C3: Third cervical ventral ramus, SHM: Sternohyoid muscle, STM: Sternothyroid muscle, OHM: Omohyoid muscle, 1: Branch to superior belly of the omohyoid muscle, 2: Branch to sternohyoid muscle, 3: Branch to sternothyroid muscle, 4: Branch to inferior belly of the omohyoid muscle.

It has been shown that AC’s lesion can lead to changes in voice quality, such as loss of voice’s pitch and prosody in singing. Such disorders might be due to loss of support given by infrahyoid muscles to the cartilages of larynx during movements of vocal folds [11, 12].

A plethora of AC’s variations regarding its origin, course, morphological patterns and branching types has been detected in the relevant literature. No AC formation has been noted in cases where C1 and C2 ventral rami are integrated with the hypoglossal nerve and C2 and C3 rami are united to a distinct inferior root [13], as well as in cases where C1, C2 and C3 rami after incorporating with the vagus nerve, are emerging from that nerve providing innervation to infrahyoid muscles [3, 4]. In particular, Caliot et al. (1986) mentioned AC’s absence in 2.5% of the studied cases [14], whereas Rath and Anand (1994) noticed such an absence in 0.25% with the AC replaced by the so-called vagocervical complex constituted of the descending branch of vagus distributed to infrahyoid muscles; the latter one branch contained C1 and C2 ventral rami [15]. Moreover, a pseudo-AC may be presented resembling to AC but not providing branches to infrahyoid muscles. In such case, the superior root is derived from the superior cervical sympathetic ganglion and the inferior root from the vagus nerve [16]. Connections or deriving of AC from the cervical sympathetic trunk, the accessory nerve, the phrenic nerve and cervical branch to sternocleidomastoid muscle have also been previously described [16–18].

AC’s superior root was found originating proximal to the posterior belly of the digastric muscle in 75% [14]
or in 92% [19], whereas the AC’s loop was noticed distal to the superior belly of the omohyoid muscle in 30% [20], 10.8% [8], 7.5% [6] and 15% [14]. Moreover, AC’s superior root was found descending on the external carotid artery in 68% [7], 60% [14] and 72% [20]. In the remaining cases, AC’s superior root descended on the internal carotid artery. Most frequently, the inferior root compared to the superior root of AC presents more variations [18, 20].

A great variability exists as regards the AC’s branches to the infrahyoid muscles and such an issue is beyond the aim of the present study. It is noteworthy to mention that occasionally some branches may provide origin to phrenic nerve [21, 22] or descend into the thorax to join the cardiac nerves or may innervate the sternocleidomastoid muscle [23]. In the latter work, the sternocleidomastoid ramus was taking origin from the superior root of AC that consisted of fibers from the hypoglossal nerve, the C1 and C2 nerves. Interestingly, in a recent research it was observed that AC’s superior root gave off branch to sternocleidomastoid muscle in a very high incidence of 24% [7]. In our study, the sternocleidomastoid branch was derived from the union of two twigs arising from the sternothyroid branch of AC. That neural trunk after innervating the inferior belly of the omohyoid muscle was distributed to the sternocleidomastoid muscle.

As regards the various morphologic patterns of AC’s loop, Jelev (2013) noticed five patterns, concerning the various nerve sources in which type I and V correspond to no AC formation, type II represents a hypoglosso-cervical ansa, type III represents a hypoglosso-vagal-cervical ansa, and type IV represents a vagocervical ansa [5]. Hegazy (2013) distinguished four forms of AC’s loop, thus U-shaped, Y-shaped, double fused Y-shaped and double separate Y-shaped loop [7], whereas Quadros et al. (2013) classified AC based on its formation as follows: normal ansa, dual ansa with absent inferior root, and double separate Y-shaped loop, whereas Jelev et al. (2013) noticed that after sacrificing the AC, no signs of dysphagia and dysphonia or palsy of the ipsilateral hemitongue was noted [4]. Nevertheless, some late changes in phonation have been reported after AC’s transaction [11]. Furthermore, the similarity of AC’s diameter to that of the recurrent laryngeal nerve makes the AC a prime neural graft choice for re-innervating the paralyzed vocal cords after recurrent laryngeal nerve damage.

Conclusions

Conclusively, surgeon of the region should be aware of the precise morphological and branching patterns of the AC in order not to damage it or/and its branches, since phonation disorders might appear. Moreover, AC’s maintenance is of great importance since it could potentially utilize as a graft in instances of paralyzed vocal cords.

References


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