ORIGINAL RESEARCH

Cadaveric exploration of Ansa Cervicalis: A Sri Lankan Study

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Abstract

Introduction: The ansa cervicalis (AC) is a nerve loop which is arising from the cervical plexus (C1–C3). As it exhibits numerous anatomical variations and as Sri Lankan studies on the area are very minimal, this study aimed to investigate the variations of AC in relation to its location which can have significant clinical implications especially during neck surgeries.

Methods: Twelve bilaterally dissected cadavers were observed to explore the variation in location and symmetry of the AC by comparing both left and right sides in relation to internal jugular vein (IJV) and central tendon of the omohyoid muscle (CT-OM). In relation to the IJV, it is classified as lateral type and medial type. In relation to CT-OM, loop was observed as superior, inferior, or at the same level.

Results: Twenty-one intact ACs were observed in eight male and four female cadavers bilaterally. There were 38% medial type and 62% lateral type ACs. In the nine bilaterally available cadavers, six (66.6%) were symmetrical in relation to IJV position and 3 (33.3%) were symmetrical in both parameters. Out of the 21 ACs, 15 (71.4%) were superior to CT-OM while four were (19%) at the same level and two (9.5%) were inferior to it.

Conclusion: Our findings highlight the diverse anatomical variations in the location of the AC. Knowledge of these variations is essential for surgical procedures and other interventions in the neck region to avoid injury and complications.

Keywords: Ansa cervicalis, Sri Lanka, Cadavers, Anatomical variation, Cervical plexus

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Introduction

The ansa cervicalis (AC) is a nerve loop in the anterior neck region which is composed of a superior root and an inferior root. Superior root is formed by C1 -C2 cervical spinal nerve fibers and inferior root is formed by the C2-C3 spinal nerves fibers of the ventral rami of the cervical plexus (C1–C3) (1,2,3). C1-C2 fibers are carried through the hypoglossal nerve to form the superior root and to supply thyrohyoid and geniohyoid muscles. The superior root descends anterior to or within the anterior layer of carotid sheath and gives motor innervation to the superior belly of omohyoid muscle. The inferior root spirals around lateral side of the internal jugular vein (IJV) and descends to join the superior root and form the ansa cervicalis. AC supplies other infrahyoid muscles such as sternothyroid, sternohyoid, and inferior belly of omohyoid except thyrohyoid muscle (4-6). Infrahyoid muscles are involved in swallowing, vocalization, and neck stabilization (7).

AC is a clinically important structure. Iatrogenic damage to the AC may occur during surgical procedures such as Thyroplasty, arytenoid adduction, Teflon injection, nerve-muscle pedicle implantation, surgery of the parotid gland, removal of the deep cervical lymph nodes, reanimation of facial paralysis using the hypoglossal nerve, and during infrahyoid myocutaneous flap reconstruction. Disruption of the AC can cause disabilities ranging from neck pain to difficulty in speaking (2).

AC is an attractive candidate for laryngeal reinnervation in cases of recurrent laryngeal nerve paralysis and also in facial reanimation surgeries where facial nerve paralysis (1,2).

Schwannomas of the ansa cervicalis are rare occurrences and are usually characterized by a painless mass in the neck. They are difficult to diagnose because they can be easily mistaken for other lesions such as carotid body tumors, enlarged lymph nodes, branchial cysts, or thyroid lesions (2).

Therefore, accurate localization of AC is clinically important. In the literature, the location of AC was studied in relation to the IJV and central tendon of omohyoid muscle (CT-OM). In relation to IJV, it was categorized as medial and lateral types. In lateral type, superior root is medial, and inferior root is lateral to IJV and when both roots are being medial to the IJV, it is named as medial type (8). AC shows numerous anatomical variations in its course, formation, location and branching pattern. So proper understanding of AC is important because it is a useful candidate in various reconstructive surgical procedures such as laryngeal reinnervation (9) and facial reanimation (10). Although there are some studies in international literature regarding AC, research in this area is minimal in Sri Lanka. So the present study was attempted to show variations of AC in relation to its location in Sri Lankan cadavers.

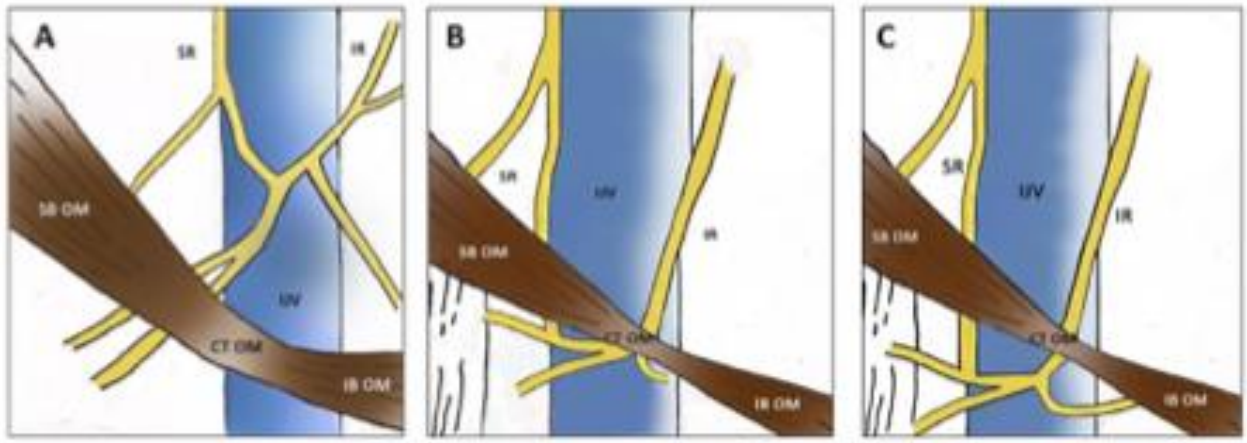

Figure 1. Line diagram of the types of the AC in relation to the Central tendon of Omohyoid muscle (CT-OM). (A) Superior type: ansa nerve loop is located superior to CT-OM. (**B) At the same level**: ansa loop is located at the same level to CT-OM. **(C) Inferior type**: ansa nerve loop is located inferior to CT-OM. *(SR, superior root of ansa cervicalis; IR, inferior root of ansa cervicalis; IJV, internal jugular vein; SB OM, superior belly of omohyoid muscle; IB OM, inferior belly of omohyoid muscle; CT OM, central tendon of omohyoid muscle)*

Methods

In this study, twelve bilaterally dissected cadavers of routine dissection classes, conducted for first year dental undergraduates at Department of Basic Sciences, Faculty of Dental Sciences, University of Peradeniya were observed to explore the variation in location and symmetry of the AC. The study was conducted over one year period, and the initial dissection was carried out by the undergraduates under the supervision and according to the guidelines provided in the Dissection Manual issued by the Department. Students were instructed to observe the medial/ lateral type of AC and report to the staff. Fine dissections were carried out by the academic staff members, who are also the investigators of this study. In some cases where location of ACs were difficult for the students, the staff members carried out the dissection procedure. The position of AC was observed in relation to the IJV and central tendon of the omohyoid muscle (CT-OM). In relation to IJV, AC was classified as lateral and medial. In cadavers where the bilateral ACs were intact, the symmetry of AC was also observed in relation to IJV. Locations of the loop of the AC in relation to the CT-OM were classified as superior, inferior and at same level (Figure 1).

Results

Out of the twelve cadavers, eight were male and four were females in the age range of 72 to 91 years with a mean age of 81 years. Out of 24 bilateral ACs, 21 were intact while the other 3 were damaged during dissections and all three were right sides. In nine cadavers bilateral ACs could be observed. .

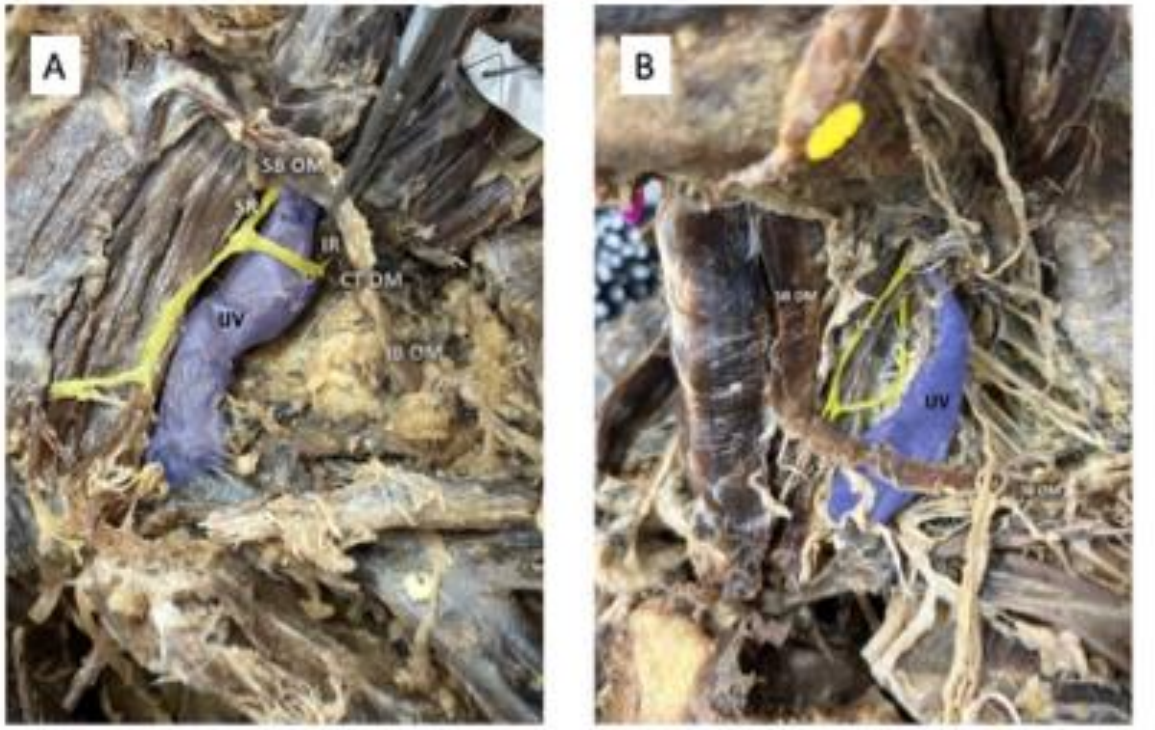

Figure 2. Types of ansa cervicalis in relation to internal jugular vein. (A) Lateral type: SR is lateral and IR is medial to IJV and the ansa is formed over the lateral wall of IJV **(B) Medial type**: both SR and IR are running medial to IJV and the ansa is formed medial to IJV. (*SR, superior root of ansa cervicalis; IR, inferior root of ansa cervicalis; IJV, internal jugular vein; SB OM, superior belly of omohyoid muscle; IB OM, inferior belly of omohyoid muscle; CT OM, central tendon of the omohyoid muscle)*

Table 1: Positional variations of Ansa cervicalis

	Right side		**Left side**		**Total**	
	Number	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Medial type	4/9	44.4%	4/12	33.3%	8/21	38%
Lateral type	5/9	55.5%	8/12	66.6%	13/21	62%
Above CT-OM	7/9	77.7%	8/12	66.6%	15/21	71.4%
At CT-OM	1/9	11.1%	3/12	25%	4/21	19%
Below CT-OM	1/9	11.1%	1/12	8.3%	2/21	9.5%

Variations of AC in relation to IJV (Figure 2)

In relation to IJV, 13 ACs (62%) were lateral type and eight (38%) were medial type. In the 9 cadavers where bilateral ACs were observed, 6 pairs (66.6%) were symmetrical with 4 lateral and 2 medial pairs (Table 1).

Variations of AC in relation to CT-OM (Table 1)

Out of 21 ACs, 15 (71.4%) were superior to the CT OM while 2 (9.5%) were inferior and 4 (19%) were at the same level as the CT-OM. In the symmetrical pairs, 3 pairs of ACs were symmetrical in relation to CT-OM as well and all being above the level of CT-OM.

Discussion

The ansa cervicalis is a nerve loop which plays a crucial role in motor innervation to several infrahyoid muscles which are important in stabilizing larynx while swallowing and phonation (6,8). As it shows numerous variations in its course, contributing roots, branching patterns, location and muscle innervation, the understanding of the anatomy and its variations of different populations are important in medical education as well in surgical practices. In this study the morphological variations of AC in relation to its location were observed. In relation to the IJV descending course the inferior root of AC has shown two main patterns as lateral and medial (8) in medial type, dissection of the carotid sheath might be needed as well to find AC (11).

In this study, the majority of ACs were located lateral (62%) to the IJV. Similar and contradictory results were there in the literature. The study done in Kenya (12) had a similar finding to ours where the majority of ACs (81.5%) were lateral to the IJV while the remaining were medial type (18.5%). Loukas *et al*., (2007) has also showed that 74% of cases were lateral and the 26% were medial to the IJV (11). A single study found in Sri Lanka also reported as 80% of ACs being lateral and 20% being medial to the IJV (13).

However, the results of this study differ from the studies done in Japan by Banneheka et al, where the majority of ACs were medial type (1,14, 15). Among them in one study 63% were medial in type, while 33.7% were lateral to IJV (15). It could be due to the variations of the anatomy among various ethnicities. Chhetri & Berke (8), in their review has mentioned that both these types can occur frequently however the lateral type showing a higher prevalence.

However, some literature has shown a third type as well which is a mixed type, where the AC contains double loops. In this third type, the inferior root has upper and lower branches, and the upper branch run posterior/medial to IJV while the lower branch travels anterior/lateral to it exhibiting the features of both lateral and medial type (1,2).

Similar to our study, a Japanese study reveals that the majority (60%) of ansa were symmetrical bilaterally regardless of its type (15). In the current study also 66.6% of ACs were symmetrical bilaterally in relation to medial-lateral types as observed in nine cadavers available.

Anastomosis occurs between superior and inferior roots by forming a loop and location of the loop is determined by the length of the loop (8). In relation to the central tendon of OM it can be classified as superior, inferior and at the level or deep to the CT OM. Regarding the length of AC, it can be further categorized into long ansa and short ansa where the union of roots occur superior to the CT OM known as short ansa and inferior to CT OM known as long ansa.

In our study the majority of ansa (71.4%) were short ACs 9.5% were long and inferior to CT-OM and 19% were at the same level of CT-OM. Our findings concur with the results of the study done in Kenya (12), where the majority of their ACs (64.6%) were also short type and Pillay also found that majority specimens (63/80; 79%) were short ACs (16).

In contrast, a study done in the United States has shown that most of the union of roots were inferior to the OM (70%) and described as long ansa and 30% were short ansa where union of roots were superior to the OM (11). Caliot et al (1986) reports that there were 64% (53 cases) with the apex of AC situated behind the inferior border of the superior belly of the OM and which is the most common arrangement of them. Further there were 19% ACs with superior type and 15% were inferior to OM according to (17). In reinnervation surgeries short ansa may not be sufficient in the coaptation of fibers. In such cases the surgeons may have to take alternative methods like the utilization of branch to omohyoid in reinnervation (18). Therefore, the localization and management of surgical approaches can be influenced by the variations of AC.

According to the literature, independent roots without forming a loop were also reported in which one root composed of C2 and C3 and innervated omohyoid and sternohyoid muscles; and a C1 root that had no connection with the vagus or C2/C3 branch, traveling independently to innervate the sternothyroid muscle (7). In addition, absence of one of the roots of ACs was also reported as in the report by Babu B.P., (2011) where the inferior root was absent and the branches from spinal nerves C2 and C3 has joined the superior root independently (19).

In contrast to the superior root, the inferior root has shown more morphological variations in its origin from the cervical plexus (17). The variations in innervation of the infrahyoid muscles from the ansa loop are also described by Banneheka, and in the review done by Chhetri & Berke (1,8).

Because of its close proximity with larynx, AC can be used as a donor nerve for laryngeal reinnervation following recurrent laryngeal nerve (RLN) injuries which can occur in thyroid cancers, thyroidectomy and esophageal cancer surgeries (3,9,16) and also less commonly it can be used as a donor nerve for facial reanimation surgeries following facial nerve palsies (10,18,20). Knowledge regarding the positional variations AC is important to prevent iatrogenic damage and accurate identification during various surgical procedures such as thyroplasty, arytenoid adduction, Teflon injection, nerve-muscle pedicle implantation, surgery of the parotid gland and removal of the deep cervical lymph nodes (2). In the other hand understanding of the position of the AC in relation to the vessels

such as IJV and carotid artery is also crucial to avoid unintentional damage to these vessels during surgical procedures where AC is involved (16).

However the authors identify several limitations of the study such as the study material being cadavers and possibility of preservation deformities, the sample was from an elderly group and allowed only a limited number as sample size. Hence the interpretations of the study findings need to be reviewed considering limitations. This emphasis the importance of further research using larger samples and possibly more finer dissections in identifying more detailed anatomy.

Conclusion

This study has attempted to highlight the variations of AC in its location in Sri Lankan cadavers which provides knowledge on the morphology and topographic anatomy of AC in light of growing significance of AC in nerve reconstructive surgeries.

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