

## Rare variations of ansa cervicalis

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Ansa cervicalis is a loop of nerve fibres, arising from the anterior branches of the cervical spinal nerves C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>, which provides innervation of the infrahyoid muscles. Usually, ansa cervicalis is formed by two roots: superior, originating from C<sub>1</sub>, and following the hypoglossal nerve; and inferior root, originating from C<sub>2</sub> and C<sub>3</sub>. Different variations in the ansa formation were found during routine dissections on 15 cadavers: lack of inferior root; a loop formed by junction of fibres from C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> at one point; a nerve bundle, originating from C<sub>1</sub>, gave rise of two separated branches, which formed the superior root; the superior root aroused as a branch of the vagus nerve; and the inferior root composed by nerve fibres, coming from the vagus nerve. These variations are important for the invasive medical procedures on the neck.

*Key words:* ansa cervicalis, variations, infrahyoid muscles, nerve grafting, neck surgery

### Introduction

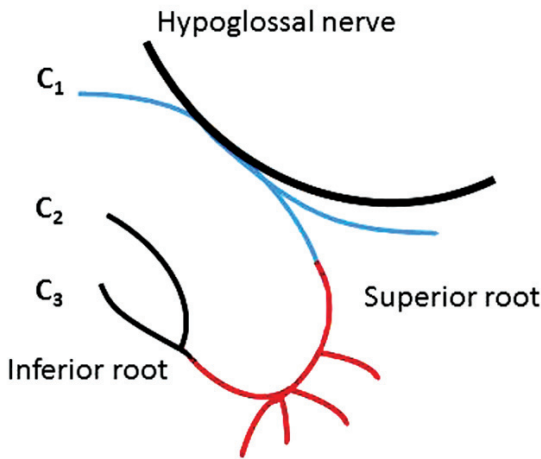
Ansa cervicalis is a bundle of nerve fibers, arising from the anterior branches of the first, second and third cervical spinal nerves (C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>), which provides motor innervation of the infrahyoid muscles. In most of the cases, the ansa is formed by two roots: superior and inferior. Fibers of the superior root originate from C<sub>1</sub>, ascend to the level of external opening of hypoglossal canal and join the hypoglossal nerve (HN). At the level of the superior margin of the thyroid cartilage, they separate HN and descend as a superior root of ansa cervicalis. The fibers arising from C<sub>2</sub> and C<sub>3</sub> join together and form the inferior root. Usually, it runs antero-laterally to the internal jugular vein. In front of the common carotid artery the two roots join together and form the ansa [13]. However, sometimes the nerve fibers are situated medially to the internal jugular vein [2]. Ansa cervicalis provides motor innervation to the infrahyoid muscles, which depress the hyoid bone [6]. It also plays a role in the phonation and deglutition [11]. In addition, some authors describe ansa cervicalis superficialis, which is formed by anastomosis between r. colli of n. facialis and n. transversus cervicis. It innervates m. platysma and the skin of the neck [15]. Quite often there are variations of ansa cervicalis, which are of great importance for the invasive clinical practice: skull base surgery, thyreoplasty, oesophageal cancer surgery, etc. Therefore, herein we report some rare patterns of the ansa topographic anatomy.

## Material and Methods

Ansa cervicalis was studied on 15 cadavers (8 male and 7 female), used for the routine dissection course for medical students in our department, during the period 2014-2017. There were no signs of any traumas in the head and neck area. The skin and the cervical fascia were removed systematically. The muscles, nerves and blood vessels were cleaned and exposed on both sides, with particular attention to the roots of ansa cervicalis.

## Results

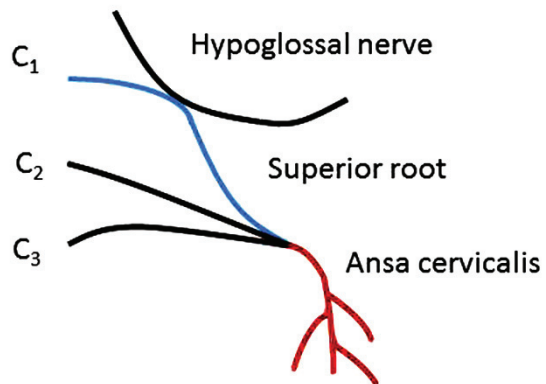
In most of the cases, in ten cadavers, bilaterally (66.7%) and in five cadavers unilaterally (16.7%), ansa cervicalis was formed in a classical way (**Fig. 1**). In one of the cadavers, unilaterally (3.3%), the superior root was formed as usually, however



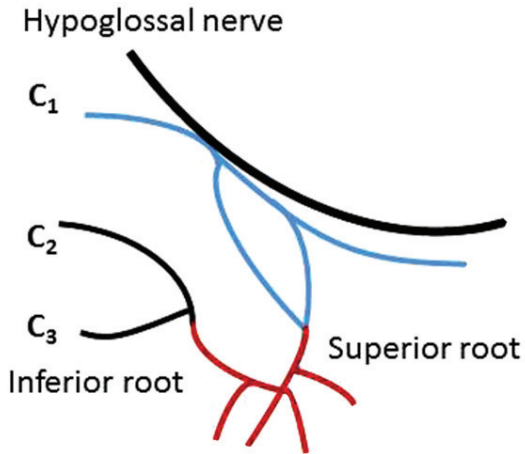
**Fig.1.** A classical ansa cervicalis.

there was no inferior root: the loop was formed by junction of fibres from C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> at one point (**Fig. 2**). Another variation was observed in one cadaver, also unilaterally (3.3 %): the nerve bundle, originating from C<sub>1</sub> and following the HN, gave rise of two separated branches, which, after course of 1cm joined together and formed the superior root of the ansa. The inferior root was formed in a classical way (**Fig. 3**). In two cadavers, unilaterally (6.7%), the superior root aroused as a branch of the vagus nerve, while the fibres of the inferior root had a standard pattern of origin (**Fig. 4**). The opposite was also observed in one

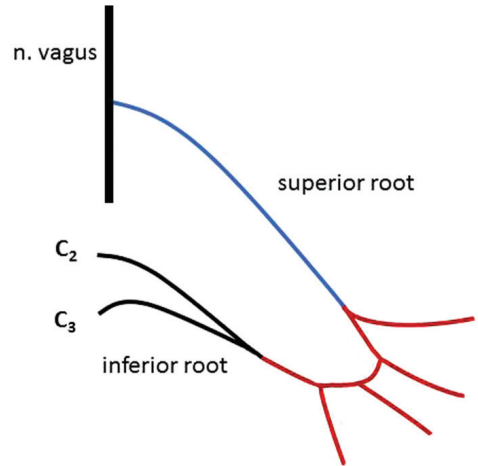
cadaver, unilaterally (3.3%): the superior root was formed in a classical way, whereas the inferior one was composed by nerve fibers, coming from the vagus nerve (**Fig.5**). Contralateral, the ansa was formed as usually. In ten cadavers (6 male and 4 female) there was superficial ansa cervicalis: anastomosis between fibers of n. transversus colli and r. colli of n. facialis. In 8 cases it was bilaterally (53.3%) and in two of them (6.7%) – unilaterally.



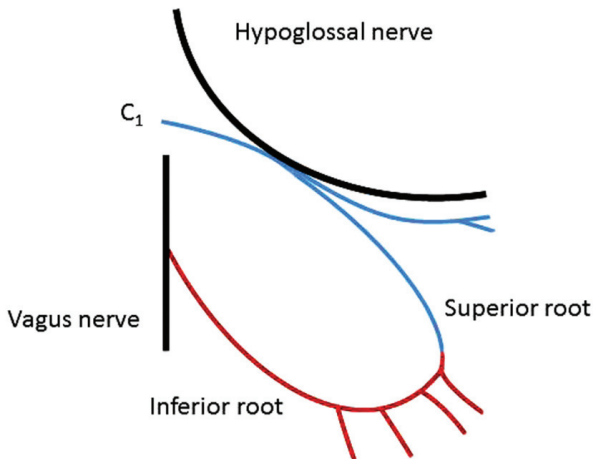
**Fig. 2.** Fibers, arising from C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> join in one point.



**Fig. 3.** Two bundles derived from C<sub>1</sub> and following the HN, gave rise of two separated branches, which, after course of 1cm joined together and formed the superior root of the ansa.



**Fig. 4.** The superior root aroused as a branch of the vagus nerve.



**Fig. 5.** The inferior root originates from the vagus nerve.

## Discussion

Variations of ansa cervicalis are not so rare. It could be even absent bilaterally, and replaced by vagocervical plexus, formed by fibres from the vagus nerve and branches, coming from C<sub>1</sub> and C<sub>2</sub> [1]. Absence of the inferior root of ansa cervicalis was reported by Challa and collaborators [3]. They found double looping of the ansa: fibres from C<sub>2</sub> join the superior root, and below this primary loop, fibres from C<sub>3</sub> form a second loop. One of our finding is similar; however, the three bundles joined at one point and formed a single trunk, providing nerve supply to the infrahyoid muscles. In addition, in one cadaver unilaterally we observed analogous double looping, though related to the superior root: two consecutive bundles branch from the C<sub>1</sub> nerve along the HN at a distance of 1 cm from each other and form the superior root. It further merges with the inferior root to form the ansa.

The formation of the inferior loop varies considerably compared to the superior one, in respect to the source of its fibres. In a comparative study on 160 cadavers, the inferior root was found deriving from the fibres of C<sub>1</sub> to C<sub>4</sub> with a major contributor C<sub>3</sub> [12]. Fibres of spinal accessory nerve also could form the inferior root [10]. As previously reported, the inferior root could arise from the trunk of the vagus nerve [9], and that is the case we observed unilaterally in one cadaver.

The superior root could originate not only from C<sub>1</sub> but also from the HN and the vagus nerve [7, 14]. Origin solely from the vagus nerve, as we report here, is a rare variation of ansa cervicalis, but nevertheless, already described by D'Souza and Ray [5]. Thus, a better knowledge of the origin, formation, and variations of the ansa cervicalis may benefit the surgical practice: to use it as an autograft for reconstruction of the recurrent laryngeal nerve [8] or to prevent injuries of the ansa during different invasive procedures at that area.

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