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Anatomical Study on Morphometry of Internal Laryngeal Nerve and its Relation to Various Anatomical Landmarks

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Abstract

The aim of the present study is to report the morphometry of internal laryngeal nerve(ILN) and its location from important anatomical landmarks.The present study was carried on 30 head and neck sections. The length of SLN was measured from its point of origin to its bifurcation and the length of ILN was measured from its point of origin to theTM piercing point. The distances were also measured from the bifurcation of common carotid artery to origin of ILN using digital calipers.The length of SLN ranged from 17 to 34 mm on the right side and 11 to 34 mm on the left side. The length of ILN ranged from 24 to 44 mm on right side and 33 to 46 mm on left side. The mean length of SLN was found to be more on the right side and the mean length of ILN was more on the left side. These differences were statistically significant ($p<0.05$). It may be concluded that the parameters reported in the present study may help the surgeons for anterior and anterolateral approach during cervical spine surgery, thyroidectomy and carotid endarterecetomy.

Keywords: superior laryngeal nerve, internal laryngeal nerve,thyrohyoid membrane, common carotid artery

Introduction

The superior laryngeal nerve (SLN) originates from the vagusat the level of the C2 vertebra and descends medially toward the thyrohyoidmembrane(TM)[1]. It divides into internal and external laryngeal nerves deep to the internal carotid artery. Theinternal laryngeal nerve (ILN)passes inferior to the greater horn of the hyoid bone, and pierces the TM accompanied by the superior laryngeal artery (SLA), a branch of the superior thyroid artery (STA)[2].ILN further divides into three branches innervating the mucosa of the epi-glottis and a small part of the anterior wall of the vallecula, aryepiglottic folds and interarytenoid muscles[3,4].

The SLN may be injured during the anterior or anterolateral cervical spine surgery, thyroid surgery andduring carotid endarterectomy [5,6]. The rate of SLN palsy varies from 9 to 14% in thyroid surgery from 1 to 4.5% in carotid endarterectomy operations and 8% in anterior cervical fusion operations. Injury to the ILN would also result in impairment of the laryngeal cough reflex [7-9]. Therefore the cranial nerve injuries, like Vagus and its branches are usually consideredin carotid artery endarterectomy [10-11].

The external laryngeal nerve (ELN) innervates the cricothyroid muscle. Injury to the SLN or ELN leads to an inability to hit high-pitched notes and easy voice fatigue [12].

The knowledge of anatomy of SLN and its branches is useful for surgical approaches,to avoid important laryngeal phonation disorders. Therefore the present study was designed to describe the morphometry of SLN and ILN. The study also considered bifurcation of common carotid artery (CCA) as an important surgical landmark using which the distances were measured.

Materials and methods

The present observational study was carried on 30 head and neck sections procured from the Department of Anatomy, Kasturba Medical College, Manipal University, Manipal during the year 2014. Specimens with gross anatomical variations of superior and internal laryngeal nerves were excluded from the study. The age and gender were not taken into consideration.The length of SLN was measured from its point of origin to its bifurcation. The length of ILN was measured from its point of origin to the point where it pierces the TM. The distances were measured from the bifurcation of CCA to the point of origin of ILN and its piercing point on the TM. The distances were measured using digital calipers. Figure 1 and 2 show the parameters measured in the study.

SPSS version 16 was used for statistical analysis. The difference between the right and left sides was analyzed using unpaired t test.

Results

The length of SLN ranged from 17 to 34 mm on the right side and 11 to 34 mm on the left side. The length of ILN ranged from 24 to 44 mm on right and 33 to 46 mm on left. The mean and standard deviations of the measured parameters is shown in table 1. The mean length of SLN was found to be more on the right side and the mean length of ILN was more on the left side. These differences were statistically significant ($p<0.05$) which was calculated using unpaired t test.

Discussion

The SLN originates from the Vagus nerve at the level of the C1 and C2 vertebra and bifurcates into ILN and ELN. The ILN may be injured during anterior approaches to the cervical spine, resulting in loss of laryngeal cough reflex, and, in turn, the risk of aspiration pneumonia. Such a risk dictates the knowledge regarding anatomical details of this nerve [15].

The distance between the origin of the SLN and the bifurcation point was reported to be 15 mm (3–20 mm) by Melamed [7], 21 mm by Lang et al. [13], 16. 7± 0.9 mm by Furlan et al. [14] and 14.1±4.2 mm by Kiray et al(15). In the present study the length of SLN ranged from 17 to 34 mm on the right side and 11 to 34 mm on the left side. The average lengths were21.6 ± 6.6mm and 18.9 ± 8.9mm on right and left sides respectively. The values obtained in the present study are in general agreement with those of Lang et al [13].

The length of ILN was reported to be 57.2±7.7 mm by Kiray et al [15],64 mm by Lang et al [13] and 44.9±1.0 mm by Furlanet al[14]. In the present study the length of ILN ranged from 24 to 44 mm on right and 33 to 46 mm on left and the average was 36.1 ± 5.8 and 40.9 ± 3.5mm on right and left sides respectively. The values obtained in the present study are in general agreement with those of Furlan et al [14].

Few studies in the literature have also measured the diameter of ILN. The diameter of the ILN was found to be 1.8–2.0 mm by Stephens et al [16] and 2.1±0.2 mm by Kiray et al [15]. However in thepresent study the diameter was not measured.

A closerelation between ILN and other important structures should be taken into consideration duringits exposure in the surgical procedures such as thyroidectomy.The ILN crosses the greater cornu of the hyoidbone, prior to piercing the TM. The distance betweenthe TM piercing point and the point at which the ILNcrosses the greater cornu was reported to be28.52±4.61 mm by Stephens et al. [16] and 25.8±5.5 mm by Kiray et al [15].In the present study the bifurcation of CCA was taken into consideration and its distance from the piercing point of ILN was measured which was 28.3 ± 4.1mm on right side and 29.5 ± 5.2mm on left side.

In the study done by Kiray et al[15] the distance between the origin of ILN and the bifurcation of CCA was 35.2±12.9 mm.In the present study it was 29.4 ± 4.0mm on right and 27 ± 6.9mm on left side.

Studies done by Melamed et al [7] and Stephens et al[16]reported the morphometry of ILN in relation to the vertebral level. But in the present study the vertebral level was not taken into consideration as the study was carried out using the sagittal section specimens.

Injury to the ILN results in impairment of the laryngeal cough reflex [7, 17]. This reflex protects humans againstforeign material aspiration that potentially could resultin aspiration pneumonia and other respiratory illnesses[16].Such a risk necessitates a clear definition of themorphometric and regional anatomy of the ILN.

The morphometric data regarding the ILN, information regarding the distances between the nerve, and the other consistent structures may help us identify this nerve, and to avoid the nerve injury during head and neck surgeries.

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Figures and legends:

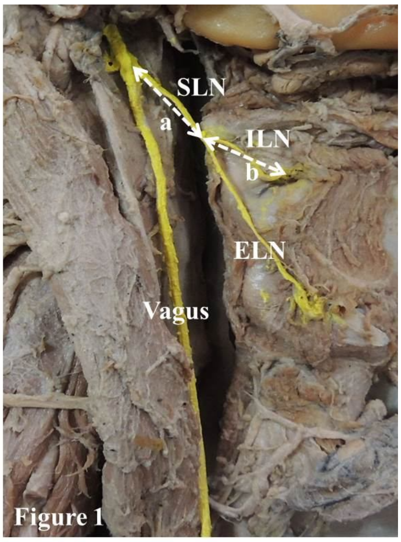

Figure 1: Specimen of head and neck showing superior and internal laryngeal nerves

SLN: Superior laryngeal nerve, ILN: Internal laryngeal nerve, ELN: External laryngeal nerve

a- Length of SLN, b- Length of ILN

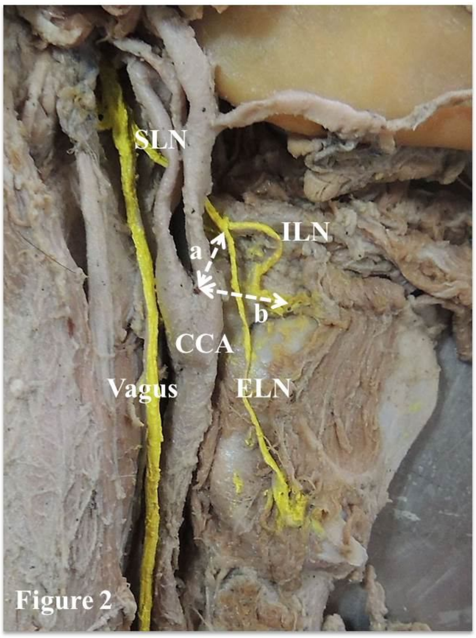

Figure 2: Specimen of head and neck showing the distances of ILN from common carotid artery bifurcation

SLN: Superior laryngeal nerve, ILN: Internal laryngeal nerve, ELN: External laryngeal nerve, CCA: Common carotid artery

a- Distance from the origin of ILN to CCA bifurcation, b- Distance from the point of piercing the thyrohyoid membrane to the CCA bifurcation.

Table:

Table1. Mean and standard deviations of the measured parameters

Parameter measured (in mm)	**Right (N=15)**	**Left (N=15)**
Length of SLN	21.6 ± 6.6	18.9 ± 8.9
Length of ILN	36.1 ± 5.8	40.9 ± 3.5
Origin of ILN and bifurcation of CCA	29.4 ± 4.0	27 ± 6.9
The piercing point of TM by ILN and CCA bifurcation	28.3 ± 4.1	29.5 ± 5.2