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Aberrant Branch of the Superior Laryngeal Nerve Passing through the Thyroid Foramen: A Macroscopical Study

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Abstract: This is the first report providing detailed description on an aberrant branch (AB) which, arising from the superior laryngeal nerve (LN), passes through the thyroid foramen and is distributed to the mucous membrane of the larynx. The foramen was observed in 7 out of 14 Japanese cadavers examined in this study, 3 on the right, 3 on the left and one on both sides. In these 7 sides, the AB was given off from the external branch of the superior laryngeal nerve (LN) during its descent on the inferior constrictor muscle of the pharynx. In one side, however, it arose from both the external and internal branches of the superior LN. In each case, the AB, after passing through this foramen, reached the lateral aspect of the arytenoid cartilage, dividing into a superior and an inferior division. The superior one was communicated with a branch of the internal branch of the superior LN, while the inferior one was communicated with that of the inferior LN of the recurrent LN. The joined branches were distributed to the mucous membrane covering the ventricle of the larynx and the vocal fold. On the basis of the height of its distribution, it can be mentioned that the AB is situated intermediate in position between the internal branch of the superior and inferior LNs.

Key words: laryngeal nerve, variation, thyroid foramen, human adult.

INTRODUCTION

The thyroid foramen in the human adults has been described by Gruber(1876), Grosser (1910) and Lang et al. (1984) as being not uncommon in occurrence. They reported that this foramen provides the passage for, in addition to a branch of the superior thyroid artery, an aberrant branch (AB) which arises from the external branch of the superior laryngeal nerve (LN) and reaches the internal structure of the larynx. They did not, however, make a detailed account of the anatomical features of the AB.

More precise features of the AB, found in the cadaver of a 35-year-old man, were described by Demmel (1978), who discussed the morphological meanings of this branch and the thyroid foramen from the ontogenetical and phylogenetical viewpoints. This author, however, did not elucidate the terminal distribution of the AB in the larynx.

In the course of an anatomical dissection at the school of medicine, we often observed the AB passing through the thyroid foramen. We report herein the anatomical features of this AB in a more detailed manner than the former reports, hoping that they will contribute to extending the anatomical knowledge of the variability of the superior LN.

MATERIALS AND METHODS

The cervical viscera including the larynx and pharynx along with the associated vessels and nerves were resected out from the bodies of 14 (7 male and 7 female) Japanese cadavers, died at the ages of 64 to 95, which had been dedicated to routine student dissection at a school of medicine. The viscera with the arteries and nerves were immersed for 3 days in 99% ethanol containing 0.001% alizarin red (sodium alizarin sulfonate; Wako, Japan) prior to and also during dissection. At this concentration of alizarin red dissolved in 95–99% ethyl alcohol, and not in water, even fine-caliber nerve branches were strongly stained red, thus allowing us to more easily identify and to elucidate their final destination. Dissection procedures were performed under a stereomicroscope by using iridectomy scissors and fine forceps.

OBSERVATIONS

Thyroid foramen

The foramen was observed in 7 out of 14 examined cadavers (3 on the right side, 3 on the left side and one on both sides). In each case it was about 3–4 mm in diameter, being located on the oblique line of the thyroid cartilage about 1 cm inferior to the superior thyroid tubercle (Fig. 1). They were overlapped by the sternothyroid muscle near its insertion onto the oblique

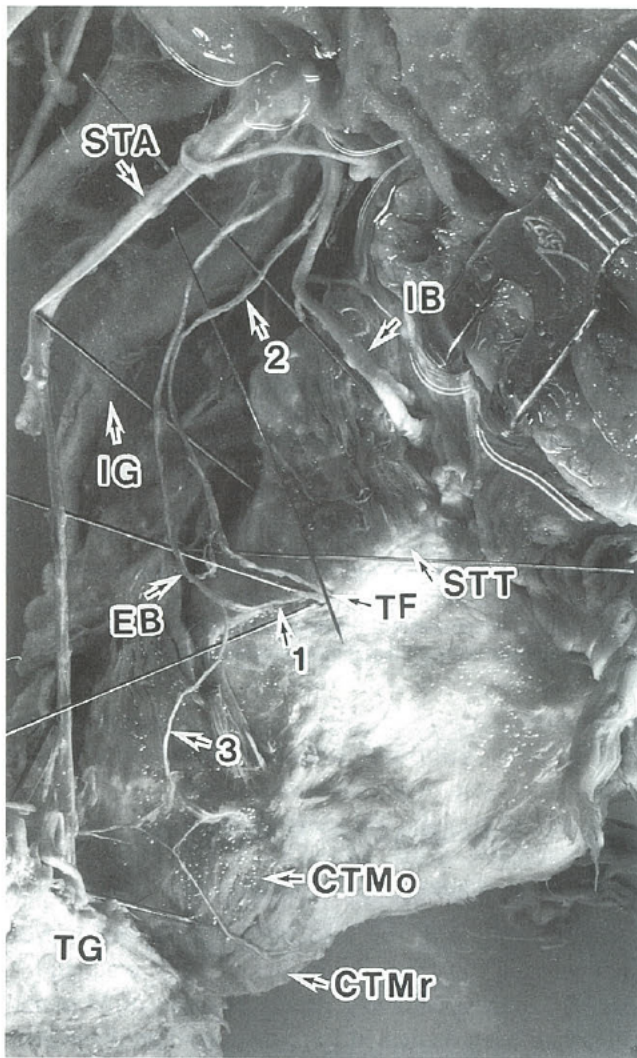


Fig. 1. Photograph of the laryngeal region of a cadaver of a Japanese female, seen from the right. The thyroid foramen and an aberrant branch are seen. In this case the branch (1) arises from the external branch of the superior laryngeal nerve, but receives an additional contribution (2) from the internal branch of the superior laryngeal nerve. The branch (3) is given to the cricothyroid muscle and the thyroid gland. $\times 1.7$

Abbreviations: AB, aberrant branch; AC, arytenoid cartilage; CTMo, pars obliqua of cricothyroid muscle; CTMr, pars recta of cricothyroid muscle; E, epiglottis; EB, external branch of laryngeal nerve; ICM, inferior constrictor muscle of pharynx; i, inferior division of aberrant nerve branch; IB, internal branch of laryngeal nerve; LCAM, lateral cricoarytenoid muscle; IG, inferior ganglion of vagus nerve; IFLN, inferior laryngeal nerve; LG, loop of Galen; PCAM, posterior cricoarytenoid muscle; PR, piriform recess; RLN, recurrent laryngeal nerve; s, superior division of aberrant nerve branch; SLN, superior laryngeal nerve; STA, superior thyroid artery; STT, superior thyroid tubercle; TAM, thyroarytenoid muscles; TF, thyroid foramen; TG, thyroid gland; VEF, vestibular fold; VL, ventricle of larynx; VOF, vocal fold; VOM, vocal muscle.

line of this cartilage. The foramen in all cases served as the entrance for a branch from the superior thyroid artery and an AB of the superior LN (Fig. 2).

Aberrant branch of the superior LN

In 7 sides, the AB arose from the external branch of the superior LN during its descent on or beneath the inferior constrictor pharyngis (Fig. 2). However, in one side of the cadaver of a Japanese female the branch received an additional contribution from the internal branch of the superior LN proximal to the thyrohyoid membrane (Fig. 1). The branch in each case coursed in company with the above-mentioned branch of the thyroid artery, descending first downward on the inferior constrictor muscle of the pharynx and then, coursing anteriorly in the interval between the lamina of the thyroid cartilage and the sternothyroid muscle, reached the thyroid foramen. After passing this foramen, the branch traversed anteriorly, and, crossing the lateral wall of the piriform recess, reached the external aspect of the arytenoid cartilage (Fig. 2). Here it split into two divisions, superior and inferior. The superior division ascended along the lateral aspect of the arytenoid cartilage, communicating with a branch of the internal branch of the superior LN (Figs. 2, 3). The joined branch coursed anteriorly superficial to the thyroarytenoid muscle, but eventually penetrated this muscle, ending in the mucous membrane covering the upper portion of the ventricle of the larynx furnished with numerous mucous glands (the laryngeal glands). The inferior division coursed anteriorly as far as the interval between the lateral cricoarytenoid and thyroarytenoid muscles where it communicated with a branch of the inferior LN (Fig. 3). The joined branch passed anteriorly deep to the thyroarytenoid muscle, and, penetrating the vocal muscle, ended in the mucous membrane covering the vocal fold and the lower portion of ventricle of the larynx.

Other findings

Communications between the branches of the superior and inferior LNs

On the inferior constrictor muscle of the pharynx, branches of the superior LN were observed to communicate with those of the inferior LN (not depicted). The internal branch of the superior LN was observed to give off a solid branch (ramus communicans cum nervo laryngeo inferiore) which descended along the posterolateral aspect of the larynx until the level of the arytenoid cartilage where it communicated with a solid branch of the inferior LN, ramus communicans cum nervo laryngeo interno, thus forming a "loop of Galen" (Williams 1951) or an "Ansa Galeni" (Lang et al. 1986)

(Fig. 2).

After giving off motor fibers to the cricothyroid muscle, the external branch of the superior LN was sometimes found to be communicated with branches of the inferior LN (Figs. 3, 4).

Sympathetic branches

Fine filamentous branches were observed to enter the foramen, being entangled to the above-mentioned branch of the superior thyroid artery (not depicted). They, however, were clearly distinguishable from the AB concerned.

DISCUSSION

Thyroid foramen

In this study the foramen was observed unilaterally in 6 and bilaterally in one out of the examined 14 cadavers of the Japanese adult, thus in 50% of the bodies or 28.6% of the sides. It could thus be mentioned that the occurrence of the foramen is not uncommon, as has been described by former authors. Gruber (1876) observed the foramen unilaterally in 42 (13 on

the right side and 29 on the left side) and bilaterally in 25 out of the examined 170 cadavers died at the ages of 6–78 years old, thus 39.4% of the bodies or 27.1% of the sides. Lang et al. (1984) described the thyroid foramen as being observed bilaterally in 10% and unilaterally in 5% of the examined larynges.

Developmentally, the thyroid cartilage is said to be derived from the ventral part of the skeletal element in the 4th and 5th branchial arches (Dubois 1886; Kallius 1897; Grosser 1910, 1912; Collins 1985). The blastemal lamina of this cartilage on each side appears at about the middle of the second month of human embryos, having the form of a slightly curved quadrilateral plate in which a foramen is observable. This foramen usually closes in later stages of development, but occasionally remains patent throughout life (Grosser 1912).

Morphological meanings of the AB

It is notable that on the basis of the height of its distribution to the mucous membrane covering the ventricle of the larynx, the AB is situated intermediate in position between the internal branch of the superior and inferior LNs (Fig. 4). Such an intermediate posi-

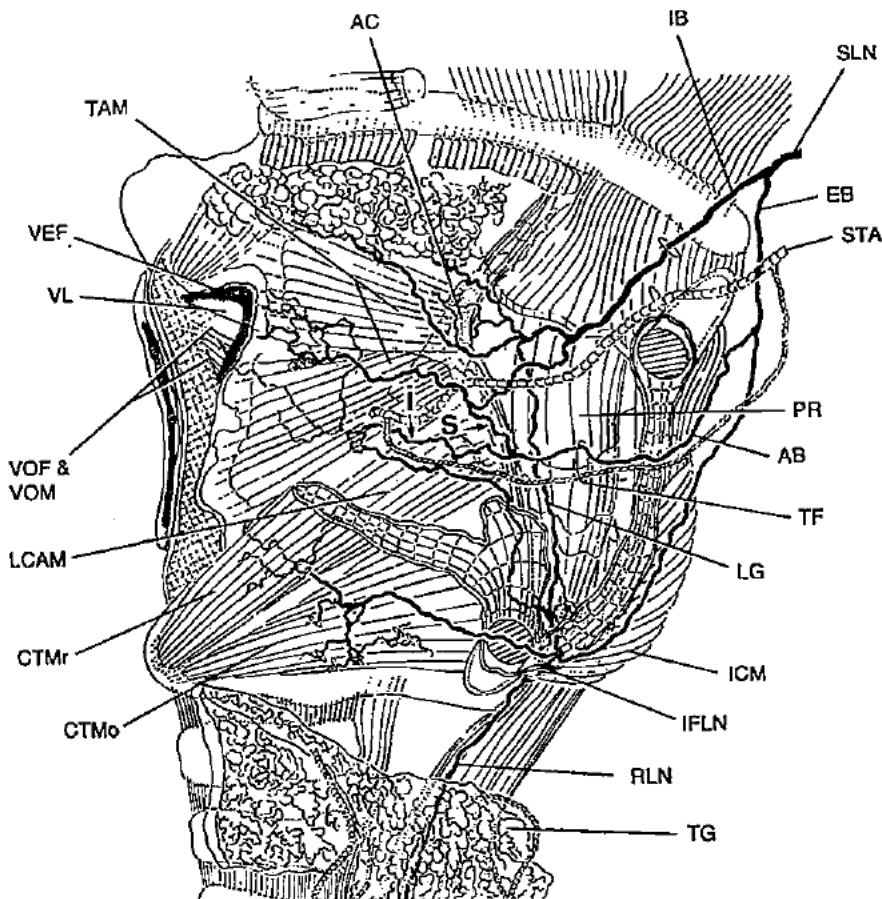


Fig. 2. Diagrammatic representation of the laryngeal region of a Japanese male, showing the course and distribution of branches of the superior and recurrent laryngeal nerves, seen from the left. Note that the aberrant branch arises, in this case, from the external branch of the superior laryngeal nerve, and, after passing through the thyroid foramen, divides into a superior and an inferior division.

tion of the AB is more clearly recognized when compared with the detailed morphology of the superior and inferior LNs in common cases (Lang et al. 1986; Sanders et al. 1993). This result raises the question of whether the AB belongs exclusively to the nerve either in the 4th or 5th branchial arch, or might receive a contribution from these both nerves. Grosser (1910), who observed a nerve branch passing through the thyroid foramen of human embryos, thus corresponding to the

AB in this study, supposed this to be the nerve in the 5th branchial arch. However, his supposition has not been substantiated by systematic studies on the development of the larynx and of the nerves in these arches. Furthermore, Demmel (1978) was against this supposition. Thus, the question yet remains open to further study.

In any event the present study has awakened our interest and desire to obtain more in-depth and precise

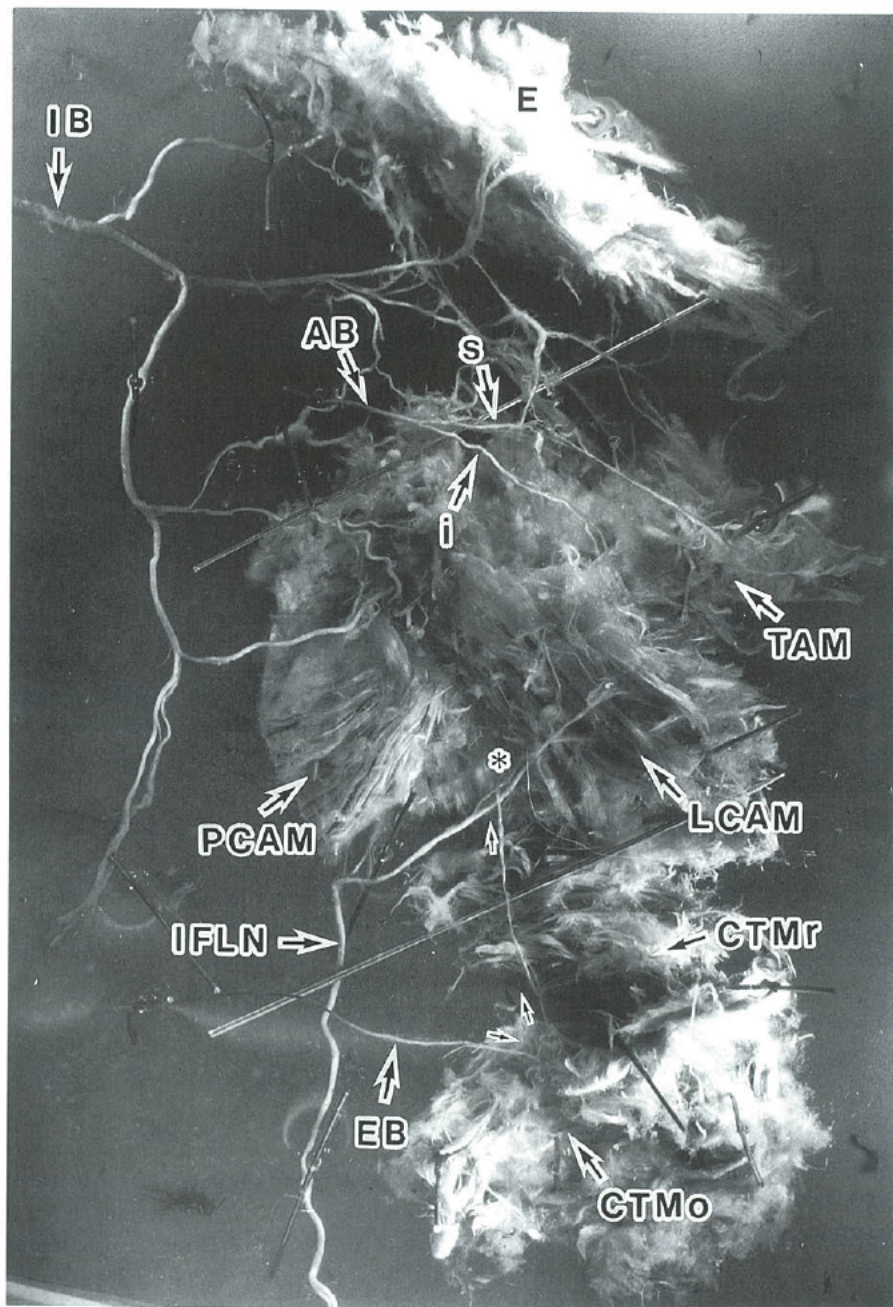


Fig. 3. Photograph of the laryngeal region of the body of another Japanese male, seen from the right. The thyroid and cricoid cartilages have been removed in order to show the entire course of the internal and inferior laryngeal nerves and of the aberrant branch. Small arrows and asterisk indicate the course of the external branch of the superior LN and the site where this communicates with the inferior LN, respectively. The pars obliqua of the cricothyroid muscle has been pulled downward from the original position in order to reveal this communication. \times 2.0

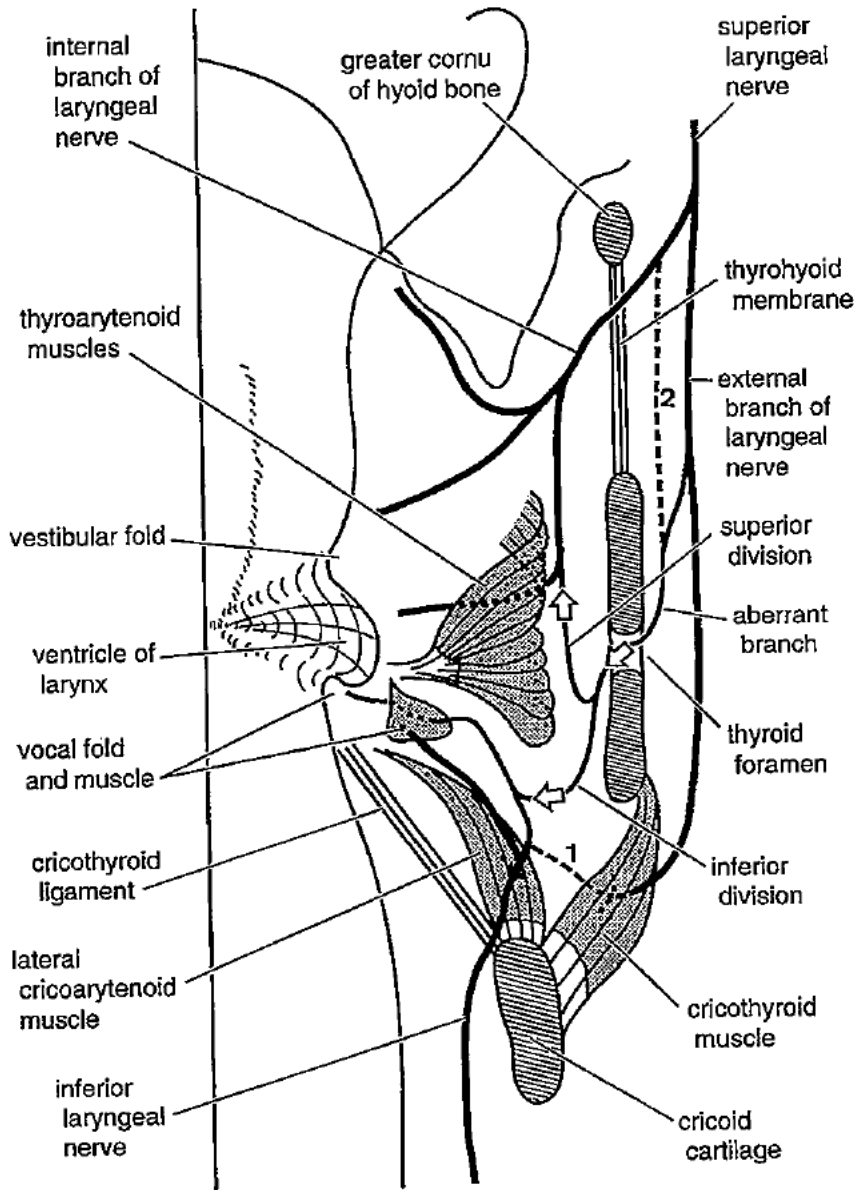


Fig. 4. A diagram to show the course and destination of the branches arising from the superior and inferior laryngeal nerves of the right side, viewed from posterior. Note that the aberrant branch is situated intermediate in position between these two nerves. Broken lines indicate communications between their branches which sometimes (1) or rarely (2) occur.

knowledge as to the development of the larynx and of the nerves innervating it.

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