

SURGICAL ANATOMY OF THE RECURRENT LARYNGEAL NERVE WITH ESPECIAL REFERENCE TO THYROID SURGERY

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FROM THE CLEVELAND CLINIC

THE surgeon who deals with pathological conditions of the neck, particularly of the thyroid, encounters one structure of vital importance, *i.e.*, the recurrent laryngeal nerve. Only those who have seen injuries of the nerve so severe as to require tracheotomy, and have realized that the impairment of the voice might be permanent, can appreciate its vital importance.

In reviewing the text-books on anatomy and the pictures which illustrate the location of the recurrent laryngeal nerve, one is immediately impressed with the fact that opinions differ considerably as to the normal position of the nerve. Thus one author describes the nerve as lying directly in the tracheo-oesophageal groove, while others describe it as lying in a

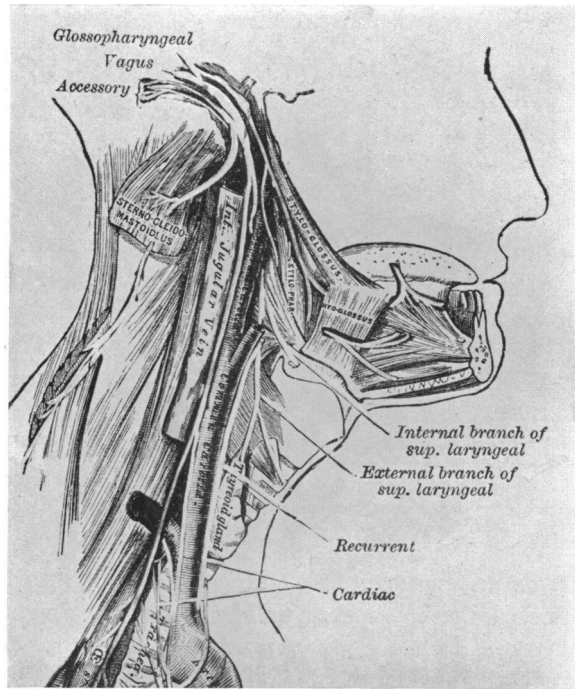


FIG. 1.—The recurrent laryngeal nerve and superior laryngeal nerve. (From Gray: *Anatomy of the Human Body*, 1918, 20th Ed., p. 909.)

lateral position. For this reason I carried out a series of dissections in an attempt to enlighten myself as to the real position of this nerve.

Let us consider first the *inferior recurrent laryngeal* nerve. Normally the tracks followed by the right and left nerves vary, so they will be discussed individually.

The *right nerve* arises in front of the subclavian artery, passes around the artery, and then passes obliquely upward to the side of the trachea. (Figs. 1-4.) Usually it passes behind the inferior thyroid artery (Figs. 5 and 6), however, occasionally it is seen in front of this vessel, and in cases in which a large adenoma of the thyroid is present at the lower pole the nerve may

be displaced anteriorly for a considerable distance. It then ascends in the tracheo-oesophageal groove. (Figs. 7-9.) About three-fourths of an inch before it enters the larynx it divides into two constant fibres. One of these divisions anastomoses with the internal laryngeal nerve which either pierces the inferior constrictor or passes beneath its inferior border, while the other branch passes into the larynx behind the articulation of the cricoid and the inferior corner of the thyroid cartilage. (Fig. 10.) This fibre supplies the muscles of the larynx, with the exception of the cricothyroid muscle.

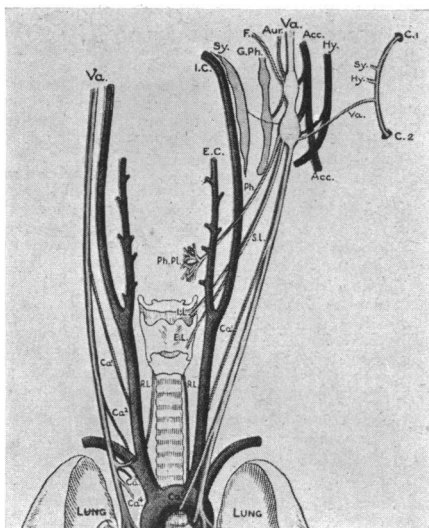


FIG. 2.—The distribution of the vagus nerve showing the right and left recurrent nerves—R. L. (From Cunningham: *Text-Book of Anatomy*, 1918, 5th Ed., p. 787.)

fibres, arising about half an inch before the recurrent nerve enters the larynx. One of these branches passes to the oesophagus, near the junction of the pharynx with the oesophagus, and the other to the thyroid gland at its tracheal attachment.

The principal difference in the locations of the left and right nerves is in their origin. While, as stated above, the right nerve arises in front of the subclavian artery, the *left nerve* arises from the vagus as it passes over the arch of the aorta. It then winds around the arch just laterally to the ligamentum arteriosum, and passes upward along the tracheo-oesophageal groove. (Figs. 12 and 13.) The distribution of branches is similar to that on the right side (Fig. 13), and although the statement has been made that the branches are more abundant on the left side than on the right, this has not been noted in my dissections. (Figs. 14 and 15.) Another difference which was noted was that in the tracheal region the right nerve lies farther to the front than does the left. (Figs. 16 and 17.) The two nerves terminate in a similar way.

The *superior laryngeal nerve* arises from the ganglion nodosum. It

The nerve gives off several small but important branches:

1. The cardiac branches, which end in the deep cardiac plexus. These branches arise as the nerve hooks around the subclavian artery.

2. The tracheal branches. As the nerve passes upward in the tracheo-oesophageal groove many small fibres are distributed to the trachea. (Fig. 11.) These nerves are important and we shall discuss them in detail later.

3. The muscular branches. As the nerve passes upward these branches are seen to run to the anterior lateral wall of the oesophagus.

4. Fibres which extend to the inferior constrictor of the larynx.

5. Two more constantly present

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receives a branch from the sympathetic nerve system through the superior cervical ganglion, and passes downward beneath the external and internal carotid arteries toward the lower portion of the thyroid cartilage, where it divides into the two terminal branches, the external and the internal laryngeal nerves.

The *external laryngeal nerve* passes downward beneath the sternothyroid muscle and supplies the inferior constrictor muscle of the pharynx and the cricothyroid muscle, in which it terminates. It also communicates with the superior cardiac nerve.

The *internal branch* passes through the hyothyroid membrane with the superior laryngeal artery and innervates the mucous membrane of the larynx. Branches also extend upward to the epiglottis and the base of the tongue. A communication between this internal branch and a terminal branch of the inferior recurrent nerve occurs after the latter has passed upward under the lamina of the thyroid cartilages.

Let us now consider the complications which result from injuries to the nerve. First of all, I

want to call your attention to the fact that such an injury may occur even when the nerve has not been actually clamped with a hæmostat, as mere traction on the gland, especially at the superior pole, may tear loose the terminal branches of the inferior recurrent nerve.

As a routine procedure in the Cleveland Clinic pre-operative and post-operative examinations of the larynx are made by a member of the otolaryngological department. This enables us to check accurately the number of paralyses which are due to injury of the nerve and to correlate the operative result with the clinical findings.

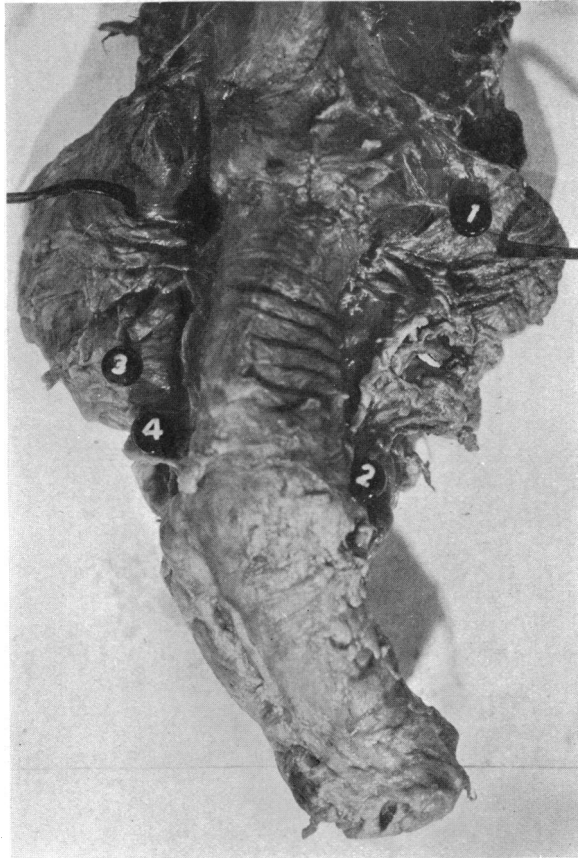


FIG. 3.—The recurrent laryngeal nerve. Anterior-posterior view. (1) Retracted left lobe of thyroid. (2) Left recurrent laryngeal nerve. (3) Retracted right lobe of thyroid. (4) Right recurrent laryngeal nerve.

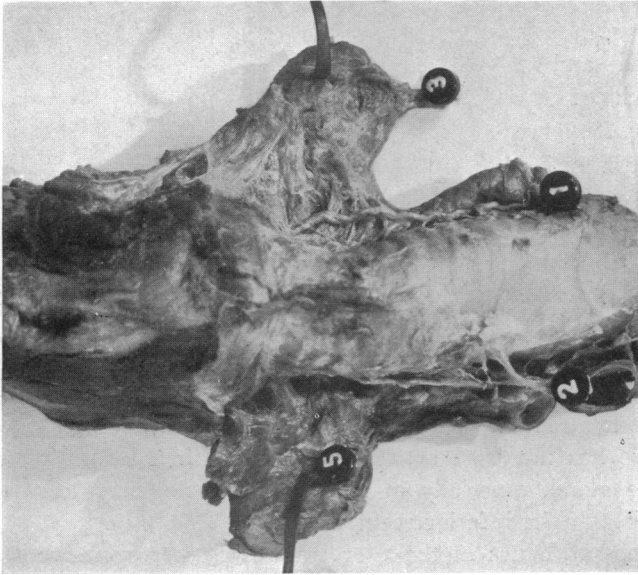


FIG. 4.—The recurrent laryngeal nerves. Anterior-posterior view. (1) Left recurrent laryngeal nerve. (2) Right recurrent laryngeal nerve. (3) Left inferior thyroid artery. (5) Reflected right lobe of thyroid.

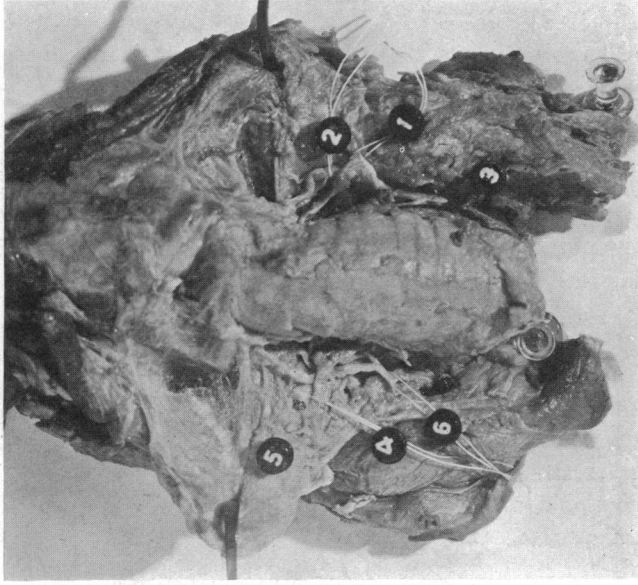


FIG. 5.—The recurrent laryngeal nerve. Anterior-posterior view. (1) Left inferior thyroid artery. (2) Left recurrent nerve passing under artery. (3) Right inferior thyroid artery. (4) Right recurrent nerve. (5) Retracted lateral lobe of thyroid. (6) Right recurrent nerve passing under artery.

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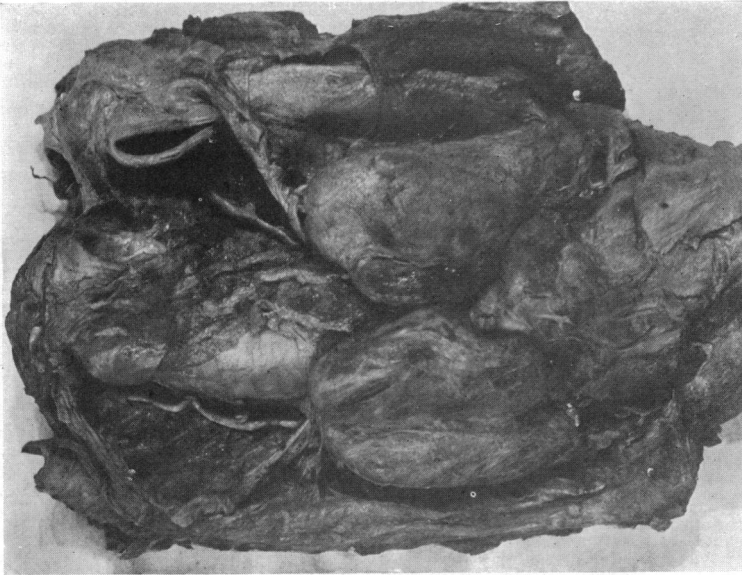


FIG. 6.—The recurrent laryngeal nerve. Anterior-posterior view. Note the nerve passing under the artery.

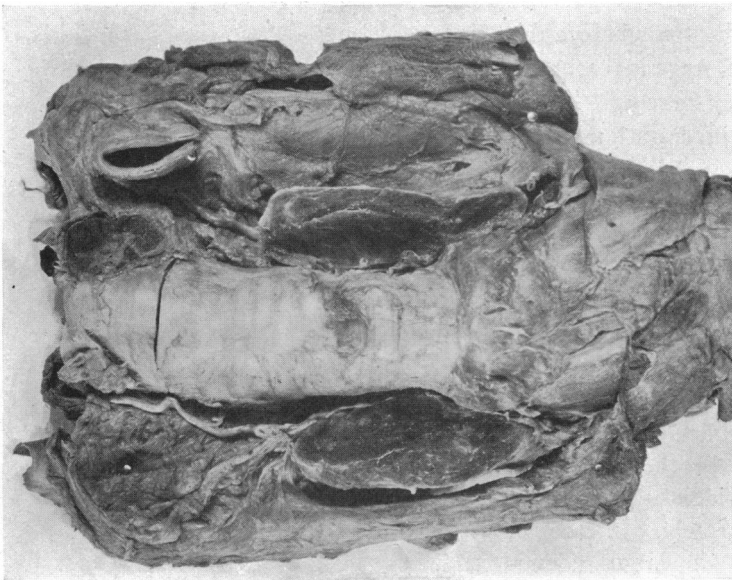


FIG. 7.—The recurrent laryngeal nerve. Anterior-posterior view. Note the nerve passing up toward the tracheo-oesophageal groove, anterior to the inferior thyroid artery.

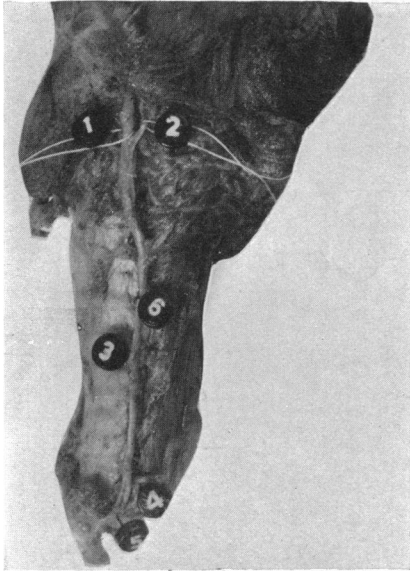


FIG. 8.—The recurrent laryngeal nerve. Lateral view. (1) Terminal branch of the left nerve passing into the larynx. (2) Division of the nerve passing into the oesophagus. (3) The trachea. (4) The oesophagus. (5) The left nerve. (6) The tracheo-oesophageal groove.

To understand the course of the dyspnoea and hoarseness which characterize these injuries we must appreciate what happens to the cords when the nerve is injured. As the result of the injury the intrinsic muscles of the larynx are paralyzed, *i.e.*, the constrictors, the dilators and the tensors. Abductor paralysis is most frequently seen, as the abductor muscles receive the predominating fibres of the recurrent nerve. A laryngoscopic examination shows that, as the cord becomes flaccid and approaches the midline, the size of the lumen of the larynx is diminished. This causes the stridor and the dyspnoea which occur during the operation. Following this, the tonus of the cord is lost, the epiglottic chink is enlarged, and the difficulty in breathing becomes less noticeable. This may be called the cadaveric position of the cord. If it is

not necessary to perform a tracheotomy before this second stage is reached, it may not be required at all.

Injury of one nerve does not always give clinical symptoms. In fact, in seventy per cent. of the cases in which a laryngeal examination reveals a unilateral abductor paralysis, the patients have been unaware of any difficulty. Compensation by the other cord has evidently taken place immediately. In cases in which a large adenomatous goitre is present, a pre-operative examination sometimes reveals a paralysis of one cord

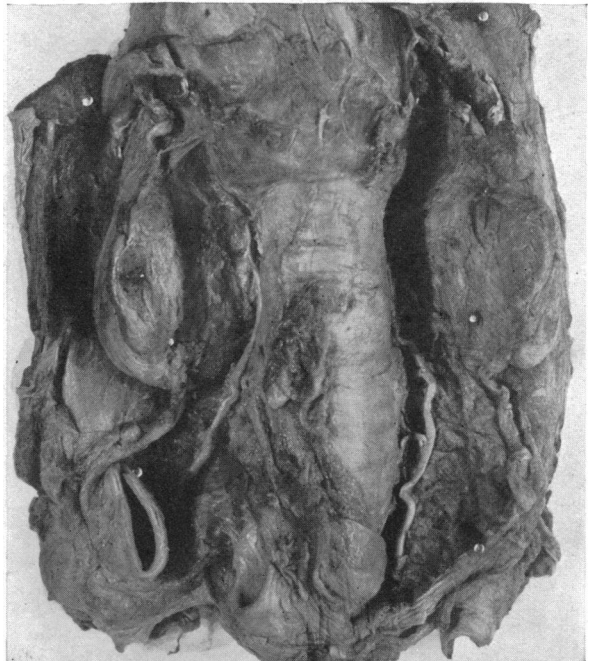


FIG. 9.—The recurrent laryngeal nerve. Anterior-posterior view. Note the right nerve passing up the tracheo-oesophageal groove.

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which has given rise to no symptoms. Usually a bilateral injury of the nerve, and occasionally also a unilateral paralysis, necessitates a tracheotomy, or the patient is unable to speak above a whisper. In very few cases, however, is a permanent tracheotomy necessary; usually the tube can be removed in one to three days and the wound allowed to heal.

A second post-operative complication which may develop is tracheitis. This can usually be anticipated during the operation, for if the trachea is denuded of its fascial covering, especially on its lateral aspect, a tracheitis invariably develops. It is undoubtedly due to injury of the trachea and to the removal of the nerve filaments which pass from the recurrent laryngeal nerve

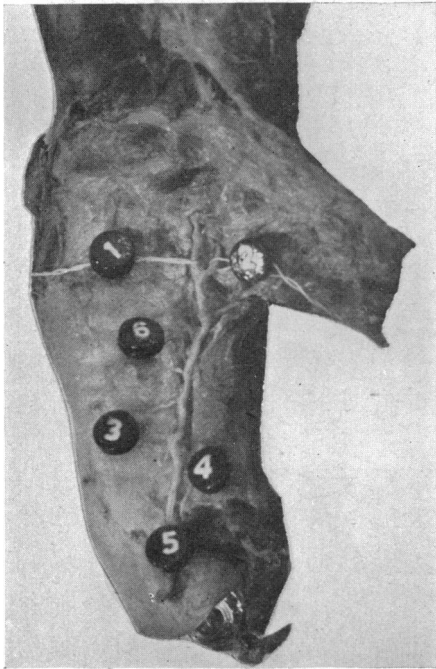


FIG. 10.—The recurrent laryngeal nerve. Lateral view. (1) Terminal branch of the left nerve passing into the larynx. (2) Division of the nerve passing into the cesophagus. (3) The trachea. (4) The cesophagus. (5) The left nerve. (6) The tracheo-cesophageal groove.

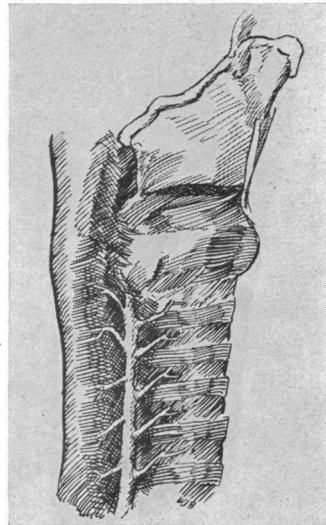


FIG. 11.—The recurrent laryngeal nerve. (Diagram) Lateral view. Note the distribution of the small fibres to the trachea.

along the anterior lateral margin of the trachea. For this reason a small amount of tissue should be left as a covering for the trachea.

Occasionally difficulty in swallowing ensues after operation. This seems to be due to an impairment of the function of the epiglottis and I believe it can be explained by the fact that a communication exists between the superior laryngeal nerve and the inferior recurrent nerve, a terminal filament of the latter connecting with the internal laryngeal nerve which arises from the former; moreover branches from the internal branch of the superior laryngeal nerve pass to the epiglottis, so that if the recurrent nerve is injured the function of the epiglottis may be impaired.

Stridor, which may be only temporary or may necessitate a tracheotomy,

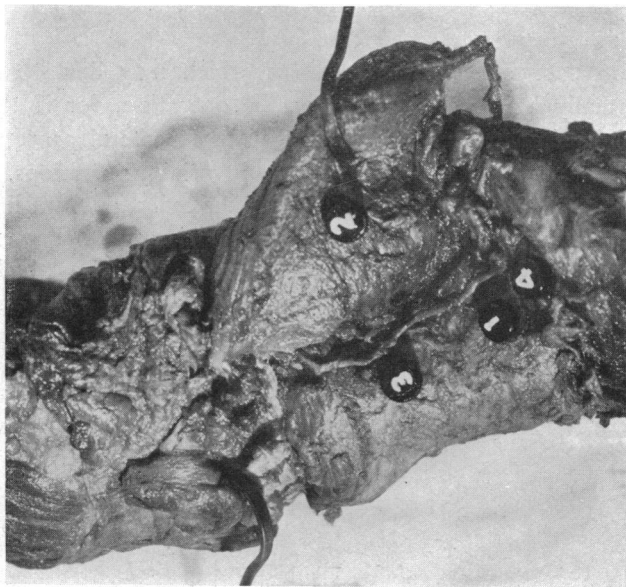


FIG. 13.—The recurrent laryngeal nerve. Lateral view. (1) The left nerve. (2) The left lobe of the thyroid. (3) The trachea. (4) The tracheo-oesophageal groove.

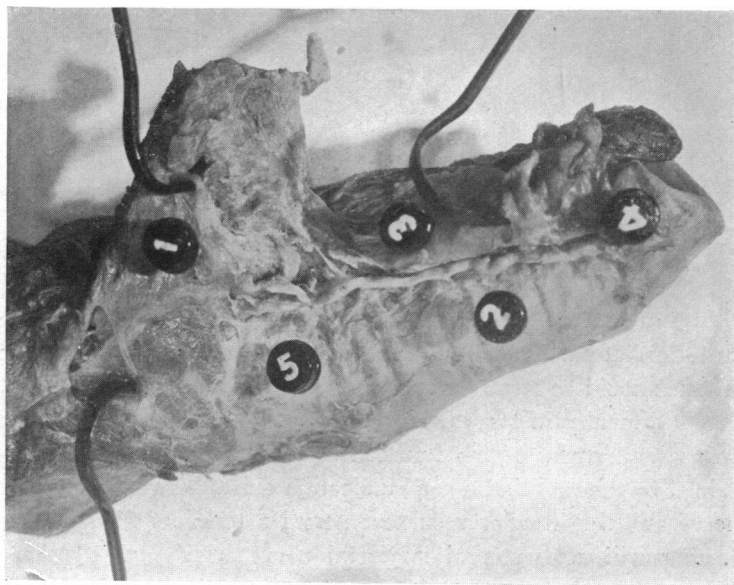


FIG. 12.—The recurrent laryngeal nerve. Lateral view. (1) Retracted left lobe of the thyroid. (2) The trachea. (3) The left nerve. (4) The tracheo-oesophageal groove. (5) A branch of the nerve passing to the trachea.

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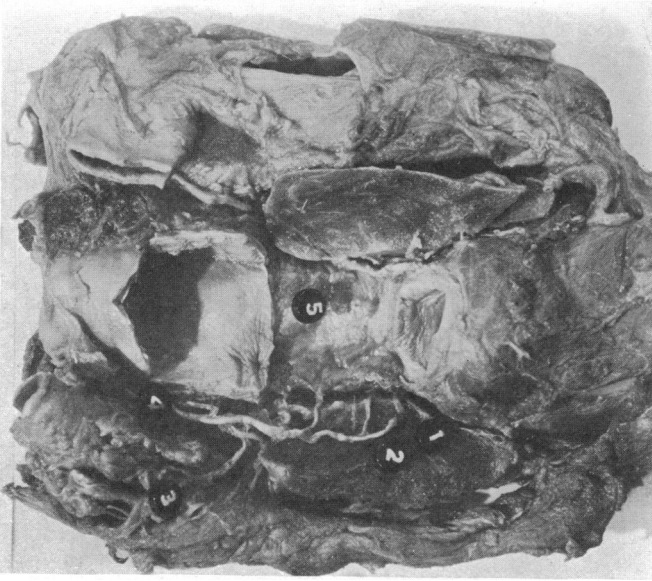


FIG. 14.—The recurrent laryngeal nerve. Anterior-posterior view. (1) Division of the nerve passing to the larynx. (2) Division of the nerve passing to the oesophagus. (3) The inferior thyroid artery. (4) The left nerve. (5) The oesophagus.

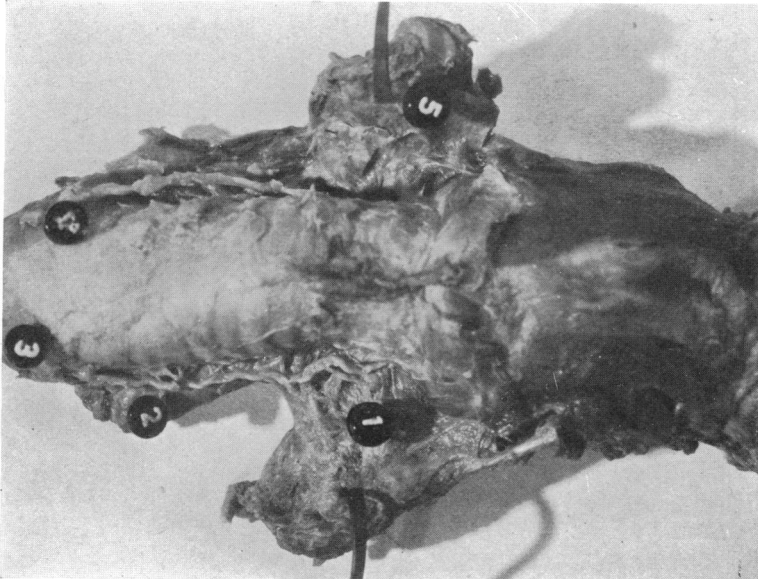


FIG. 15.—The recurrent laryngeal nerve. Anterior-posterior view. (1) Retracted left lobe of thyroid. (2) The left nerve with filament passing to the trachea and the oesophagus. (3) The left nerve. (4) The right nerve. (5) Retracted right lobe of the thyroid.

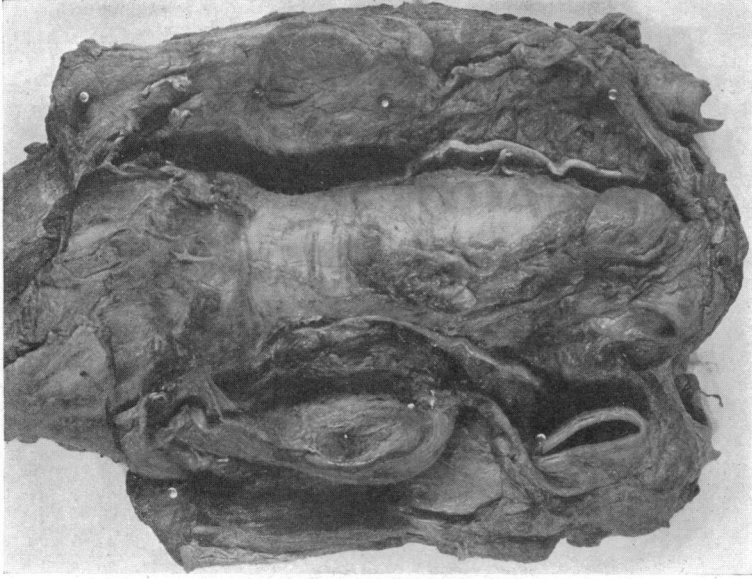


FIG. 17.—The recurrent laryngeal nerve. Anterior-posterior view. Note that the right nerve lies farther to the front than does the left, which has been displaced upward.

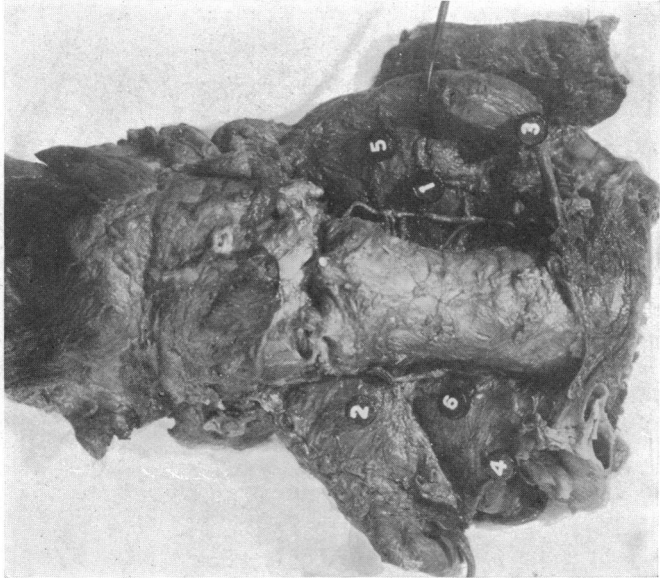


FIG. 16.—The recurrent laryngeal nerve. Anterior-posterior view. (1) The left nerve. (2) The right nerve. (3) The left inferior thyroid artery. (4) The right inferior thyroid artery. (5) Retracted right lobe of the thyroid. (6) The carotid artery. Note that the right nerve lies farther to the front than does the left.

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may result from injury of the recurrent nerves. When this complication follows operation the patient is watched constantly and is never left alone. First of all the cords are examined to ascertain whether the paralysis is unilateral or bilateral. If the stridor continues, the pulse and respiration remain rapid, the accessory muscles of respiration are over-active, and the patient complains of the effort involved in breathing, a low transverse tracheotomy is performed *provided cyanosis is not present*. Occasionally compensation occurs in from four to six hours, in which case the tube can be removed

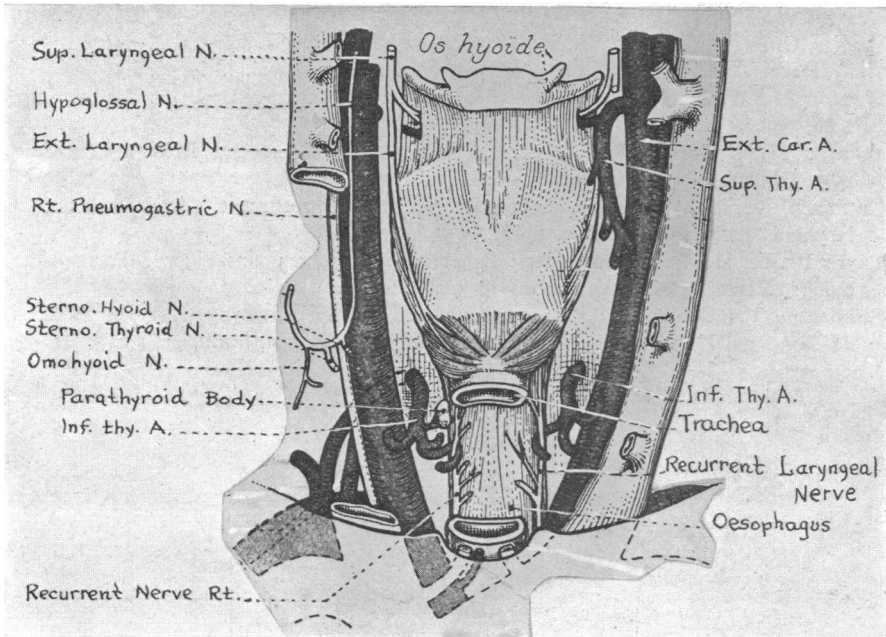


FIG. 18.—Relation of the right recurrent laryngeal to the hypoglossal nerve. (From Pauchet and Dupret: *L'Anatomie en Poche*, 1926, Plate 133).

and the trachea reapproximated with one chromic catgut, the patient making an uneventful recovery.

If the damage is permanent, a permanent tracheotomy tube may be worn, or a plastic operation on the nerve may be attempted. In August, 1926, Frazier and Mosser¹ reported the results of anastomosis between the descendens noni branch of the hypoglossal nerve and the recurrent laryngeal nerve. (Fig. 18.) Improvement was noted in 60 per cent. of their cases. Anastomosis with the phrenic nerve has also been accomplished.

Operations for the relief of injury of the laryngeal nerves have been described by Hoessly,² Schmerz,³ Guttman⁴ and others. In 1915 Payr⁵ described a plastic operation on the larynx for unilateral nerve injury and Schmieden⁶ has recently reported a very successful result following such an operation.

CONCLUSIONS

1. The prevention of injuries of the recurrent laryngeal nerve demands an accurate understanding of the anatomical relations of the nerve on the part of everyone who deals with surgery of the larynx or of the thyroid gland; (2) the fact that anomalies of the nerve may occur must constantly be kept in mind; (3) the patient who has suffered an injury to the recurrent nerve must always be kept under close observation in order to prevent an unfortunate sequel.

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