

THE NERVES OF THE HUMAN LARYNX

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IN 1884 Exner published a paper on the nerves of the larynx. It was based on experimental work and on dissection. His experiments were of two types: they consisted of (1) cutting the laryngeal nerves of dogs and rabbits and months later killing the animals and noting what muscles had degenerated. (2) Stimulating the nerves and noting what muscles contracted. His dissections consisted of the microscopic examination of three larynxes of newly-born children. One of these he cut into 150 serial sections and the other two he used for determining minute or obscure points.

On this work he showed that the innervation of the larynx was much more complicated than had been previously thought. He showed that the superior laryngeal nerve was not a purely sensory nerve and that the inferior laryngeal was not purely motor. He furthermore discovered in rabbits a new nerve which he called the middle laryngeal.

His results were opposed by Onödi, whose work I have not been able to use. But Nicolas in Poirier and Charpy (1903) follows Exner's description, even reproducing two of his diagrams.

Exner's description seems to be the popular one on the Continent; on the other hand, English speaking anatomists follow the older and more classical description.

The differences between the two descriptions are very great. The classical description restricted the internal laryngeal to a purely sensory function. The other teaches that each laryngeal muscle has a double nerve supply from the superior and from the inferior laryngeal nerves.

The description given here is based on naked eye dissections of 33 adult larynxes. Ten of these were used for microscopic work after the nerve supply of the arytenoideus had been worked out (Bielchowsky's method was used), but as this work did not give satisfactory results, the remaining 23 were not sectioned. The distribution of the other nerves was worked out in addition to the arytenoideus in these specimens.

THE EXTERNAL LARYNGEAL NERVE

A branch of the superior laryngeal, variable in size, generally small. It runs downwards and forwards, deep to the sterno-thyroid and close to this muscle's attachment to the thyroid cartilage. The corresponding artery is superficial to the muscle.

At first it lies on the inferior constrictor, but as it approaches its termination it passes deep to the inferior constrictor and lies on the thyroid cartilage.

The nerve passes under those fibres of the inferior constrictor which are attached to the inferior tubercle of the thyroid cartilage.

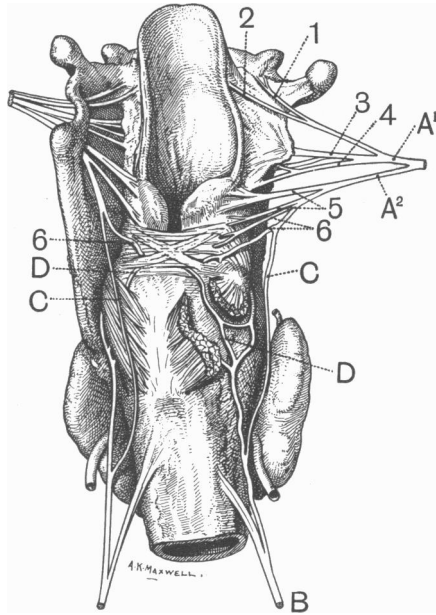
The nerve winds closely round this tubercle, enters the crico-thyroid muscle on its superficial surface where it breaks up into its filaments for the supply of the muscle. There are two possible explanations of its close relationship to the inferior papilla. (1) That the nerve is pulled round this to supply the reflected part of the muscle which is attached to the internal surface of the thyroid cartilage; (2) that filaments go to join the inferior laryngeal nerve. In two specimens I have found such filaments, but they are exceedingly small and difficult to find; they join the inferior laryngeal as it passes over the crico-arytenoideus lateralis.

As the nerve passes deep to the inferior constrictor muscle, it gives off a constant twig to the muscle and two other inconstant twigs.

(1) To the apex of the lateral lobe of the thyroid gland.

(2) A branch which passes upwards to the region of the superior tubercle of the thyroid cartilage. In three larynxes out of 23 this nerve passed through a foramen in the cartilage. In two it ended in the cartilage and no foramen was found.

This foramen was present twice on the left side, once on the right. In a fourth specimen it was present on both sides and in this specimen it contained an artery. The foramen in this specimen was larger than in the other cases. The artery was apparently that branch of the superior thyroid which is stated to accompany the internal laryngeal nerve, but which really enters the larynx through the thyro-hyoid membrane on a lower plane quite close to the thyroid cartilage. When the nerve passed through the foramen it joined the internal laryngeal nerve.



THE INTERNAL LARYNGEAL NERVE (fig.: A¹ and A²)

The internal laryngeal nerve enters the larynx through the thyro-hyoid membrane. As already mentioned, the artery enters the larynx on a lower plane quite close to the superior border of the thyroid cartilage and separately from the nerve.

While it is in this membrane it divides into two main divisions. One, the larger, runs horizontally inwards towards the mesial plane (fig.: A¹). The

other runs downwards through the sinus pyriformus, in the aryteno-epiglottic fold deep to the mucous membrane (fig.: *A*²).

This latter branch is the one usually called the internal laryngeal but it is less than half the internal laryngeal. The other is referred to as a leash or sheaf of fine filaments. This sheaf can be reduced to a simple and fairly constant plan. It will be found to consist of four main twigs which give off many secondary twigs (fig.: 1, 2, 3, 4).

The first turns upwards immediately it gets through the membrane. Sometimes it appears before the main nerve pierces the thyro-hyoid membrane. It runs upwards in the membrane to be distributed to the mucous membrane of the lateral wall of the pharynx and lateral to the glosso-epiglottic fold. The second passes mesially and upwards to sink into the anterior surface of the epiglottis just mesial to the attachment of the glosso-epiglottic fold. It supplies the mucous membrane in the vallecula.

The third runs horizontally inwards and ends on the anterior surface of the epiglottis quite close to its fellow of the opposite side. The epiglottis is getting narrow at this level which is just below the superior border of the thyroid cartilage. This twig gives branches to the mucous membrane of the vestibule.

The fourth passes downwards and mesially to end on the anterior surface of the epiglottis close to the attachment of the thyro-arytenoid and thyro-epiglottic muscles. It supplies the mucous membrane of the false vocal cord and the region just above it.

Three of these twigs, it will be noted, end definitely on the epiglottis.

THE DESCENDING DIVISION OF THE INTERNAL LARYNGEAL (fig.: *A*²)

This runs down in the mesial wall of the sinus pyriformis giving off two or three branches, to the muscles in the aryteno-epiglottic fold, to the mucous membrane, and to the mucous glands on the posterior surface of the arytenoid cartilage (fig.: 5).

Then it gives one and sometimes two branches to the inter-arytenoideus muscle. This branch was present in 31 out of 33 specimens—so I venture to say it is quite constant. It sinks into the posterior surface of the muscle just above the oblique part of the muscle, arising from the arytenoid cartilage of the same side (fig.: 6).

It goes right through the muscle and can be found to end on the posterior surface of the cartilage; before it does so, it gives definite twigs to the muscle and frequently a little twig to join the branch coming to this muscle from the recurrent laryngeal nerve. The nerve is then continued down on the posterior surface of the arytenoideus posticus deep to the mucous membrane, lying in a well-marked layer of connective tissue; here it gives off many fine twigs to the mucous membrane but none to the posterior surface of the crico-arytenoideus posticus as Exner states.

It ends by piercing the inferior constrictor and joins the inferior laryngeal

outside the larynx. This is usually described as being the ramus communicans superior joining the ramus communicans inferior of the recurrent laryngeal. But it is difficult to say where one begins and the other ends. There is no anastomosis to mark out their junction and I describe it as above to suggest a continuous nerve. On the other hand, it might be looked on as a continuation of the inferior laryngeal upwards (fig.: C).

THE INFERIOR OR RECURRENT LARYNGEAL NERVE (fig.: B)

The right nerve lies more anteriorly on the trachea than the left, but on each side they enter the larynx at the same place. Each nerve gives off branches to the trachea and oesophagus in its course upwards.

About an inch before it enters the larynx it divides into two divisions and also at about the same place it gives off two other fairly constant fine twigs. One goes to the thyroid gland where this is attached to the trachea, the other makes for the oesophagus just below its angle of junction with the pharynx.

Of the two main divisions, one is the branch which unites with the internal laryngeal. It is the branch already described as the continuation of the internal laryngeal. It can be picked up before it enters the larynx. It is the smaller of the two. It enters the larynx by piercing the inferior constrictor at the angle of junction of the oesophagus with the pharynx. The larger division lies more laterally. This pierces that part of the inferior constrictor which arises from the cricoid cartilage, immediately behind the articulation of the inferior cornu of the thyroid with the cricoid. It is the muscular division of the nerve. Branches of the inferior thyroid artery are in close relation with the nerve, as it enters the larynx, the artery being on a more anterior plane but some of its branches may pass behind the nerve.

In the Larynx:

The course of the smaller division has already been described.

The larger division, or muscular division.

It runs upwards at the lateral border of the crico-arytenoideus posticus muscle as far as its attachment to the muscular process of the arytenoid cartilage. In this part of its course it first of all gives off a branch to the crico-arytenoideus posticus muscle which enters the deep surface of the muscle. It then gives off a twig which passes deep to the crico-arytenoideus posticus muscle to appear at its upper border and then enter the posterior surface of the inter-arytenoideus muscle. This is the branch of supply from the inferior laryngeal nerve. As it lies deep to the arytenoideus posticus, it is joined by a twig which winds round the groove on the posterior surface of the cricoid cartilage immediately below the crico-arytenoid articulation. This twig comes from the main part of the recurrent nerve (fig.: D). In this way it is seen that the inter-arytenoideus muscle gets a double nerve supply on each side. The branch from the recurrent laryngeal is frequently joined to the branch from the internal laryngeal of the same side. Neither nerve goes across the mesial plane to the opposite side.

The twig from the inferior laryngeal nerve ends in a different manner to that of the internal laryngeal. It breaks up very quickly into its filaments of distribution and does not go through the muscle to end on the cartilage. This nerve can be quite easily picked up as it appears at the upper border of the crico-arytenoid posticus, in the little triangular space bounded by the mesial plane, the crico-arytenoid and inter-arytenoideus muscles. As already stated this double nerve supply seems to be constant.

The inferior laryngeal nerve then lies on the superficial surface of the crico-arytenoideus lateralis. Here I have twice seen it joined by a small twig from the external laryngeal nerve. It gives fine twigs to this muscle and then ends by sinking into the thyro-arytenoid muscle. Here I have seen it joined by a twig from the internal laryngeal nerve.

To sum up there are four ways of looking at the laryngeal nerves:

(1) The classical way, following Luschka, that they are separate sensory and motor nerves.

(2) The school of Exner which says they are mixed motor and sensory nerves and that each muscle receives a double nerve supply.

(3) An obvious middle way which says that the nerves are mixed nerves but which denies that all the muscles have a double nerve supply. This is what I found: that the arytenoideus was supplied by the internal and recurrent laryngeal nerves, but that the rest including the crico-arytenoideus posticus had only a supply from the recurrent laryngeal. This fits in with the pathological facts.

(4) It seems to me however that such an explanation does not fit in with all the facts. For example, the connections between the various nerves. So I suggest that the laryngeal nerves are really a plexus of nerves. Just as the vagus breaks up into its various plexuses in the body, it does the same in the larynx. It is a highly modified plexus. I would further suggest it arose by the larynx separating a strand of fibres from the vagus—that this strand is represented by the continuous nerve joining the internal and recurrent laryngeal, and that the separation from this strand of further fibres forms the various nerves of the larynx.

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