LUMLEIAN LECTURES

ON THE

PATHOLOGY OF THE PNEUMOGASTRIC NERVE.

Delivered at the Royal College of Physicians.

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LECTURE I.—*Concluded.*

THE pneumogastric may be affected as a whole, and the symptoms presented in diabetes are perhaps the best illustrations of this general condition of disease. An interesting paper on this state was published in the *Medical Times* of 1856 by the late Dr. Charles Shearman, on Neurosis of the Pneumogastric Nerve; he drew attention to the depression of spirits, to the loss of memory, the malaise, the sense of exhaustion at the stomach, with yawning and sighing, and often with palpitation; to the disturbance of digestion, and, in many instances, to the diabetic condition of the urine: these symptoms often manifested a periodical character, and, when the condition was early recognised, were amenable to treatment. In true diabetes, the branches of the pneumogastric are especially affected, and we find not only the glyco-genic function of the liver disturbed, but the other parts supplied by the pneumogastric are involved, the pulmonary nutrition is interfered with, and a chronic pneumonia is often induced; palpitation and disturbance of the heart are common symptoms, and the voice is often altered in character. There is the closest sympathy with the sympathetic nerve and with the cerebrum; hence other common symptoms attending the disease, such as the impaired nutrition, the red tongue, the dry skin, the altered appetite, the confined state of the bowels, and, at a later period, diarrhoea; and, as to the brain itself, the melancholia which is often induced. The same connection of the pneumogastric branches with the vaso-motor nerve is seen in that remarkable disease, exophthalmic goitre. With impaired nutrition we find enlargement of the thyroid, protrusion of the eyeballs, and an irritable condition of the heart; and sometimes with a saccharine condition of the urine, as in a young gentleman of superior scientific attainments, aged about 23, in whom, with an extremely sensitive condition of nervous system, we had well marked exophthalmic disease with a recurrent glycosuria; the branches of the pneumogastric in him were especially prone to morbid action.

It may facilitate the right understanding of our subject, if we take the several parts supplied by the nerve in connection with the laws which have been just adduced; and first the larynx. The larynx may be affected by spasmodic irritation, or weakened by paralysis; and each of these may be central in character, or be produced by local or by peripheral causes.

Spasmodic irritation.	Central	In epilepsy and functional disease of brain
		In laryngismus stridulus
	Local	In whooping-cough In catarrh and laryngitis In croup and diphtheria In the different forms of ulceration, etc. In irritation of the uvula
Paralytic weakness	Peripheral	In aneurism pressing on the recurrent nerve In early phthisis In heart disease In enlarged glands In hysteria
		In exhaustion
	Central	In disease of brain, as apoplexy In cerebral aphonia In glosso-laryngeal paralysis In diphtheria In aneurism In pressure on the pneumogastric or recurrent nerve by tumours In hysterical aphonia

In the paroxysm of an epileptic convulsion, the larynx is spasmodically affected; but, in this disease, not only are the premonitory symptoms of the most varied character, but we find that, in the interval between the paroxysms, vague sensations are produced, which

are evidently traceable to the same cause. An impression is made upon the nervous system of which the patient alone may be conscious, and one or other branch of the pneumogastric may in this way be involved: the stomach, the heart, the lungs, and the throat. It may be a sense of choking or of dyspnoea, or more severe spasmodic irritation. If the cause be recognised, treatment will be more successful. The following may serve as an instance of this kind of irritation of the pneumogastric nerve. An officer, aged 45, who had served some years ago in India, and afterwards in the West Indies and Canada; whilst in India, he had a fall from his horse, which was attributed to sun-stroke; there was concussion of the brain, and he lost the sense of hearing on the left side, and also the sense of smell. From that time, he had become nervous and dyspeptic; he did not suffer from headache, but slept badly, and had morning cough; his pulse was feeble, but otherwise he seemed in good health; his chest was strong, abdomen contracted, urine normal; but he had repeated attacks of "sighing", with sense of choking and distress about the upper part of his chest. He had never contracted any syphilitic disease, and was a water-drinker. In the West Indies, he had fever slightly. It was quite evident that this condition was due to functional disturbance of the brain, and the "choking" sensation and sighing to the state of the pneumogastric nerve. Bromide of potassium, with arsenic and cinchona bark, have removed these unpleasant symptoms.

In a young university graduate, aged 19, attacks of the most violent spasm of the throat came on in the following manner. He had previously felt well till he overfatigued himself with a long walk; the following day, he had a paroxysm of difficulty in breathing, and there was a recurrence each day with increasing severity. He would suddenly start up, throwing his arms into the air, the face becoming livid, the eyes staring; he would then, in the wildest manner, force his hand into his mouth, as if to tear something from the throat; after a few minutes, there was the expectoration of thick mucus and a little blood; the attack then gradually subsided. A loud crowing inspiration took place during the paroxysm. The attacks were so severe, that it seemed as if the danger to life were imminent. At 10 P.M., the respiration was 28; pulse, 100; temperature, 100.4 deg.; the skin perspiring, the throat free from injection; and there was no diphtheritic membrane. The tongue was clean, the bowels confined, the respiration was easy; there was no sibilus and no laryngeal sound produced during ordinary respiration; no rhonchi, nor change in resonance in the chest; the respiration was, however, rather less free than normal at the right base; he could swallow fluids; there was no dysphagia, but great sensibility of the epiglottis. He had no cough; in fact, he was afraid to cough, on account of the throat-spasm. He was ordered a dose of castor-oil, and bromide of potassium, ʒi; tincture of belladonna, m x; dilute hydrocyanic acid, m ii; and compound tincture of chloroform, m x, in water every four hours. He inhaled steam with two drachms of hemlock-juice in it.

About half-past three, another severe paroxysm came on, but soon subsided, and they became less frequent. In a few days, he recovered, and there has been no return of laryngeal or other symptoms of disease since: now five years ago. This severe form of disease was a spasm of the glottis, and closely resembled the laryngismus stridulus which is more frequently found at an earlier age. It was evident that there was irritation of the pneumogastric nerve, either at its root or of the recurrent laryngeal nerve; it was a neurosis of the larynx, and a condition of hyperæsthesia; but it was due not to any local change in the part, but to an affection of its nerves. This, in fact, is the pathology of laryngismus stridulus; sometimes it is due to mischief at the origin of the nerve, and the spasm of the glottis is a slight convulsion, which may be followed by a more general one, the fingers and the toes being turned in, as in membranous inflammation of the brain, or it may be produced by reflex irritation, as by intestinal affections, or from the pressure of enlarged glands on the recurrent nerve of the neck. In infants, this form of malady may be produced by slight disturbance, as from the teeth, from the bowels, and an attack, even the first one, may be so severe as to lead to a fatal result.

There is much doubt as to the true pathology of whooping-cough; according to Dr. Copland, it has its seat in the medulla oblongata; and some speak of it as a neurosis of the pneumogastric nerve; but there can be no doubt that the parts supplied by the pneumogastric are especially affected; the spasmodic condition of the glottis, the urgent dyspnoea and cough, with the closed state of the rima, producing the lividity of the countenance and the long drawn inspiratory sigh; then also the irritability of the chest, often followed by cough and by emphysema, and the great sensibility of the stomach, so that vomiting is very easily induced, show that the whole of the branches of this nerve are exquisitely sensitive. The fact that it is a disease com-

municable by contagion does not militate against the idea that it is the pneumogastric that is especially affected. The same remedies which are available in relieving spasm of the throat lessen the severity of this disease; and, when the malady becomes more severe, the irritation is prolonged from the origin of the pneumogastric to other nerve-centres, and general convulsion is induced. In measles also, another contagious disease, we find great sensibility of the pulmonary branches of the pneumogastric.

In reference to spasmodic affections of the throat produced by local irritation, we have not space to describe them, but would only say that, in all forms of local disease, such as catarrh, laryngitis, croup, diphtheria, strumous or syphilitic or cancerous ulceration, the affection of the mucous membrane very readily induces spasmodic contraction of the muscles of the part, and this condition aggravates the distress due to the inflammatory disease.

The spasmodic diseases of the larynx which are due to peripheral irritation are of a very interesting kind, and we will very briefly advert to them. In many instances of relaxation of the uvula and mischief about the throat, cough and irritation of the epiglottis are due to direct disturbance. The elongated uvula may come into contact with the epiglottis itself; this, however, is not always the case, and the disturbance of the superior laryngeal is reflex.

This reflex disturbance is more decided in aneurismal disease of the aorta and of the large vessels of the neck, which may induce pressure upon the recurrent nerve. At first, this may be mere spasmodic irritation from slight disturbance, and afterwards the disease may lead to paralysis of the part, from long-continued pressure. As the recurrent laryngeal nerve supplies nearly all the muscles of the larynx, spasmodic contraction is easily induced. At first, there is very little affection of the voice, but sudden paroxysmal dyspnoea, which often comes on at night. The patient awakes in great distress, and is unable to get his breath. The distress is sometimes extreme, and this symptom is often one of the most prominent indications of aneurismal disease of the aorta. There may be nothing observable on laryngoscopic examination of the throat; no change in the voice, no affection of the pupil; and the general physical signs of disease may be very imperfectly developed. A case of this kind occurred many years ago in Guy's Hospital, before, I would say, the laryngoscope was used. The patient was a strong man, without any symptoms of heart-disease, but with occasional difficulty in swallowing, and with the paroxysmal distress just mentioned. My former teacher and colleague Dr. Addison diagnosed aneurism, although the œsophageal symptoms were more decided than the other indications of disease; and the termination of the case showed the disease to be aneurismal in character. In pressure upon the larynx and trachea from aneurism and tumour, laryngeal spasm greatly aggravates the dyspnoea and distress.

Another form of reflex irritation is that affection of the larynx which is produced by disturbance of the peripheral branches of the pneumogastric in the lung. The voice is changed, and a dry hacking cough, with laryngeal irritation, seems to indicate mischief in the windpipe, but it is really due to reflex irritation. A patient will often describe the mischief as being in the throat itself, when, by careful examination, the commencement of tubercular disease is found in the lung. These instances are, of course, to be distinguished from those in which, at a later state of chronic phthisis, disease in the larynx and in the vocal cords is induced and ulceration takes place.

Again, in heart-disease of an organic kind, we also find reflex irritation of the laryngeal nerves. This state is to be distinguished from the urgent dyspnoea which is produced by the disturbed relations of the lungs and heart; thus the blood is unable to pass from the lungs, in consequence of contracted mitral valve, and thereby the respiratory act is imperfectly and hurriedly performed, and the lung is surcharged with blood. Besides these cases, we have instances of heart-disease, whether from valvular disease or weakness, in which sudden laryngeal distress is produced and urgent dyspnoea. This paroxysm often takes place about two or three in the morning; the patient is suddenly roused from sleep, because the respiratory centre does not receive its proper supply of aerated blood; the involuntary muscles of respiration during sleep being unassisted by the muscles of forced respiration, which had served to maintain the balance of the respiration and circulation, are alone insufficient, and, after a time, the need of the system rouses the patient to take a deep inspiration and to supply more oxygen. This explanation will, however, not suffice for many instances in which the patient may be awake, and breathing to the utmost of his capabilities, but still the laryngeal spasm comes on. In other instances of functional disease of the heart, from weakness and from dilatation, we find similar sudden laryngeal spasm produced.

The same symptoms of reflex irritation by pressure upon the recurrent laryngeal nerves may be caused by enlarged glands in the neck or

in the upper part of the chest; and, in some instances during early life, the condition is one precisely resembling that of laryngismus stridulus produced by cerebral irritation. In gastric disturbance, an irritable dry cough and perverted sensation of the superior laryngeal nerve may be induced; a tickling in the throat, which the patient can scarcely distinguish from actual local irritation of the part, or the spasmodic affection may be more decided in character.

In hysteria, the spasmodic affections of the larynx are closely connected with those of the œsophagus; a sense of choking from spasmodic contraction in the latter is associated with difficulty of breathing from spasm of the former. The sensation as of a ball in the throat, the globus hystericus, is not limited to the gullet, but extends to the windpipe; there is gasping for breath, with irregularity, and often afterwards hurried respiration.

It is not necessary to dwell further upon these spasmodic laryngeal affections; but we pass on to consider those which are of a *paralytic* character, where there is loss of power or anæsthesia; these also may be divided into those which are of central origin, those which are local in character, and, lastly, the peripheral. As to the first, we find loss of power in both recurrent nerves in states of great exhaustion; and when the origin of the par vagum has lost its active power, the insensibility of the superior laryngeal nerve may allow food to pass into the larynx, as during syncope, and also towards the close of life: it is of importance to bear this fact in mind, otherwise sudden cessation of life may be produced by laryngeal obstruction. This loss of sensibility is to be remembered in the severe form of disease which has been designated labio-glosso-laryngeal paralysis; and we have already referred to an instance in which the attempt of a patient to swallow milk when the larynx had lost its sensibility led to its sudden passage into the trachea, and caused death. In this disease, the malady is central; it is at the central origin of the nerve, and probably at the part where the spinal accessory, facial, the hypoglossal, and the par vagum are brought into close relationship at the floor of the fourth ventricle. Trousseau refers the disease to the spinal accessory nerve, and regards the branches of nerve supplied to the larynx as being derived from that nerve, at least as far as the power of speech is concerned; whilst the pneumogastric has especially to do with the respiratory act. I will briefly give the facts of the case just mentioned.

A plumber by trade, aged 46, was admitted into Guy's Hospital, under my care, on November 9th, 1874. He had not suffered from lead-poisoning nor from syphilis. Twelve months previously, he began to lose the power of mastication, and he had some difficulty in swallowing; there was partial deafness on the left side. The symptoms came on gradually, and steadily increased in severity. The appearance of the patient was very peculiar: the vacant expressionless countenance, with the mouth partially open, was very characteristic of the disease. The symptom which first attracted attention was the diminished power of the muscles of mastication, and this was associated with gradually increasing weakness. At length, one month before admission, he could only take fluid food; the facial nerve was greatly diminished in power, but was not completely paralysed; for he could close the eye and partially distend the cheeks; the mouth was half open. The left auditory was affected, but the sensory portion of the fifth was unaffected; for there was no loss of sensation of the face. The appearance of the tongue was most distinctive; it remained powerless at the floor of the mouth, and the soft palate was motionless. This state led to the most prominent of the symptoms of disease, the inability to swallow or to masticate food properly, and also to pronounce those sounds which require the action of the tongue and of the lips; deglutition could not be performed, the movements could not be executed, and the attempt was followed by choking; food reached the edges of the epiglottis, and was violently ejected by the nostrils, and the patient nearly asphyxiated by the attempt. He coughed up a good deal of phlegm, but he did not seem to have power to clear his throat thoroughly. With the laryngoscope, the vocal cords could be seen to open and close as in health; still the superior laryngeal nerve did not seem to possess its normal sensibility. He was greatly exhausted when admitted, and, as the paralysis of the hypoglossal was marked, and swallowing could not be performed, it was directed that he should be fed with the stomach-pump; milk was administered in this way. The following evening, however, he again attempted to swallow; a few hours afterwards, he sank. Some of the milk had passed into the larynx, for white coagula were found in the bronchi. The *post mortem* examination, very carefully made by Dr. Goodhart, showed that there was a small patch of softening immediately above the right corpus olivare; the floor of the fourth ventricle was deep in colour; its lateral angles and the valve of Vieussens were softened, and there was a minute patch of the same change in the structure of the cerebellum beneath. The right hypoglossal was smaller than the left, and, in the

cervical spinal cord, the right anterior horn was softened. The parts affected were the origins of the hypoglossal and facial nerves, but those of the spinal accessory and pneumogastric presented less decided change. It was interesting to find, however, that the recurrent nerve seemed to retain its power over the vocal cords, although the superior laryngeal nerves had diminished sensibility.

In reference to a weakened condition of the vocal cords, or diminished tension, or loss of contractile power, the disease may be of central origin, or local, or of a reflex character. We often find, in reference to the first, that the disease is in the will; the effort to produce contraction of the cords is not made; the patient speaks in a whisper. A few months ago, a patient of this kind was under my care in Guy's Hospital who had not spoken for two years; there was no evidence of organic disease, and the first application of an electric current to the larynx produced the loudest protestations that she could speak. This state has been called by Romberg phthisical aphonia. Sudden nervous shock may also produce this loss of power of the vocal cords. Other weakened conditions of the nerves of this part are due to local disease, to diphtheria, croupous diseases; and even after catarrh the muscles become weakened, and sympathise in the inflammatory affection of the mucous membrane. The application of electricity often affords great relief, and, in milder cases, the effort to produce musical notes and to sing tends to increase the tension of the weakened cords.

Still more interesting are the forms of paralysis of the recurrent nerve and of the vocal cords which are due to reflex action. Any form of pressure upon the recurrent nerve may induce altered nutrition and hoarseness, the consequence of the paralysis; for the recurrent supplies the vocal cords and, with one exception, the muscles of the larynx. The larynx may be examined by the laryngoscope, which becomes an important help in diagnosis, and the vocal cord may be seen on one or other side to be weakened or powerless. In an interesting paper by Dr. George Johnson in the *Medico-Chirurgical Transactions* of 1875, he shows that, whilst pressure on one recurrent nerve, on the same side, will produce spasmodic action or paralysis, pressure on the trunk of the nerve will cause atrophy or spasmodic action on both sides. Aneurismal disease is perhaps the most frequent cause of this reflex paralysis—reflex in its being produced, not by direct injury of the larynx, but upon it by secondary pressure; not reflex in the sense of an impression being conveyed to the nerve-centre, and then propagated to the affected part. These instances are very different in character from those already described as due to a central cause. Enlarged bronchial glands, cancerous disease, and it is said that pleuritic thickening about tuberculous lungs will induce this change by affecting the recurrent nerve.

A very interesting case of this kind was lately under my care in Guy's Hospital. A strong man, aged 43, an engineer, who, with the exception of rheumatism, had good health till last Christmas; cough then came on, and increased in severity, with dyspnoea, till his admission on February 23rd. His face and neck were swollen and oedematous, the superficial veins of the thorax enlarged; there was complete dulness on the right side of the chest, with absence of respiratory murmur; the signs of thoracic tumour were well marked; the arms became swollen, the dyspnoea increased greatly in severity, and erysipelatous inflammation affected the right arm. The voice was feeble, but was not lost. He died on March 14th. On inspection, a cancerous tumour was found in the anterior mediastinum; it pressed upon the innominate and azygos veins; the right lung was in a sloughing condition; the right pneumogastric was involved, and there was very marked affection of the recurrent on the same side; it was involved in the growth, and, to quote the description of Dr. Fagge, "the larynx was healthy, except the right vocal cord, which was swollen and yellow". The swelling was very decided, and the nutrition was so affected, that suppurative changes had commenced; but there was no suppuration about the muscles of the neck. The patient was too ill to bear the use of the laryngoscope.

Many of the instances of reflex paralysis which are associated with functional disturbance of the uterine organs are closely allied to those which have been referred to as hysterical aphonia.

These varied affections of the larynx may be produced by disease at the origin of the nerve—the pneumogastric—or the disease may be reflex in character, the irritation of one series of nerves affecting other branches, as of the lungs, or of the stomach, or of the larynx; and, lastly, these laryngeal affections may give place to disturbance of the lungs or of the stomach, alternating the one with the other; a patient at one time having aphonia, then spasmodic irritation of the bronchial tubes, or functional disturbance of the digestive organs. In the one case, the attempt should be made to relieve the central mischief; in the second, to lessen the primary source of peripheral disturbance; in the third, to remove the general irritability of the nervous system.

THE CROONIAN LECTURES ON THE PATHOLOGY AND RELATIONS OF ALBUMINURIA.

Delivered at the Royal College of Physicians.

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LECTURE I.—*Concluded.*

2. *Granular Kidney.*—Passing now to the more chronic disorder, that which is recognised as the granular kidney, and occasioned by creeping fibrosis, we have to describe a condition which begins with, and belongs essentially to, the connective and vascular structures which are external to the proper secreting elements. The change begins in disproportioned growth, somewhat of a rank luxuriance, in the fibroid tissue with which the arterial channels are uniformly fringed. Hypertrophy of this part leads to atrophy of all the rest. Creeping along the arterial lines with slow and hesitating steps, involving the organ not all at once, but by little and little, the disease makes itself felt not suddenly, but with so gradual a departure from health, that its date is usually indeterminable, and its existence unsuspected until it has reached an advanced stage. And in other respects, too, in its progress and symptoms, it affords a precise converse to the more acute disorder. One selects the young, the other the old. One is certainly local to the gland; it is in dispute how far the other is general to the system. In one case, dropsy is generally present; in the other, it is present only occasionally. One is characterised by obstructed ducts and suppressed secretion; the other by obstructed blood-vessels and secretion, enhanced at least in its watery part.

To look more narrowly into the organic derangement proper to this more chronic disorder, it may be said to be accurately declared by the superficial loss of level to which the term granulation is applied. This condition is only produced by a drawing in of the surface at certain points by a contractile growth, the distribution of which is determined by that of the blood-vessels around which it begins. Sometimes the granulations are small, regular, scarcely changed in colour, and evidently but mere exaggerations of the minute lobules into which the blood-vessels divide the surface; in other cases, the granulations are large and hemispherical, each conspicuous by the contrast between its white colour and the purple or pink depression by which it is surrounded. The light-coloured striking granulations result from a more active and dangerous form of the disease, one which involves deeper and wider injury to the gland, and more marked symptoms than those which are less noticeable. The contractile process, of which the granulation is the sign, usually involves loss of bulk and weight; but not always so; the atrophy of the glandular structure may be more than made up for by the new fibroid growth and the epithelial accumulation which is apt to occur as the result, apparently, of a catarrhal process set up in the course of the disorder. The essence of the disease, as it first takes substance and shape, is a multiplication of nuclei with subsequent fibrillation in the interstitial tissue. Spreading from the capsule inwards along the arteries, surrounding concentrically the Malpighian bodies, imbedding, compressing, and strangulating the tubes in its path, while others for a time escape only to yield to its later encroachment, the growth overruns the gland little by little, after the manner of the invader who likened his scheme to the eating of an artichoke leaf by leaf. The new growth is widely distinguished from the original fibrous structure of the organ. It consists largely of nuclei, like foetal structure or a fibro-plastic tumour. It occurs in great breadths between the glandular structures, as having thrust itself wedgewise between them, and displaced them by its increasing bulk. It gives evidence of active growth and development, not only by its spreading to the destruction of the older structures, but by the acquirement sometimes of quite a rich supply of capillary blood-vessels. These are sometimes to be traced by the blood they contain, in appropriate distribution through large masses of the intrusive material. That they are components of the new, not remnants of the old structure, is evident by the regularity of their arrangement, by their remote-