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*Due to the Application of Chromic Acid
to Granulations on the Upper and
Posterior Portions of the
Tympanic Membrane.*

A CONTRIBUTION TO THE PHYSIOLOGY OF
THE CHORDA TYMPANI NERVE.

BY

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Medical Department of Columbia University, New York.

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THE PHYSIOLOGY OF THE CHORDA TYMPANI NERVE.*

BY ROBERT LEWIS, JR., M. D.,

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MRS. —, of German birth, superintendent of one of our city hospitals, aged about forty-eight years, of average good health, not of a nervous temperament, certainly with no hysterical tendency, active, though weighing over one hundred and eighty pounds, consulted me about a year ago for a left chronic otitis media purulenta, which had existed for a number of years. She had been treated both here and in Germany a number of times, and this was an exacerbation of the disease, in character similar to a number of previous attacks; a muco-purulent discharge, slightly offensive, and a dull evanescent pain being the only symptoms of which she complained. On examination, I found in the tympanic membrane, after cleansing the canal, a

* Read before the American Otological Society at its thirtieth annual meeting.

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perforation about two by three millimetres in diameter, the superior margin of which was formed by the posterior fold, the anterior margin by the malleus handle, the posterior margin by the posterior edge of the annulus tympanicus. The opening was filled with granulation tissue.

Under cocaine anæsthesia, I removed, by curetting, as much of the granulation tissue as possible, then cauterized the base with chromic acid, and ordered the patient to use a bichloride solution (1 to 6,000) as an aural douche three times daily, to be followed by the instillation of a few drops of a solution of fifty-per cent. alcohol (afterward increased to seventy-five per cent.). Later, the solutions were stopped and insufflations of powdered aristol were used. Finally, after the third application of chromic acid, I did not see my patient professionally for some time, but when I did meet her casually she informed me that her ear was all right, but that during the night of the same day on which she made her last visit to my office her tongue became so swollen that she could hardly breathe for a few hours. I paid but little attention at the time to her account of this occurrence.

About six months later Mrs. — again visited my office, complaining of a renewal of the discharge. I found a little granulation tissue present, and used the chromic acid as on the previous occasion. The next day I learned that, about twelve hours after I had made this application, her tongue began to swell very rapidly — indeed, so rapidly that in two hours she could not protrude it, nor could she shut her jaws; and the swollen parts interfered so markedly with her breathing that Dr. George F. Little, of the house staff, had seriously considered the advisability of performing a tracheotomy. Happily, by the administration of purgatives and by the local employment of ice, tannic acid, and leeches (the latter applied near the angle of the jaw), about three hours after the œdema first showed itself the swelling began to subside, and within twenty-

four hours after the application of the chromic acid the œdema had practically disappeared. Accompanying the glossal œdema and the œdema in the submaxillary region were small areas of œdema over the right frontal eminence, over the balls of both thumbs, over the internal malleolus of one ankle joint, and under the ball of the right foot. I also learned that the first attack which she had (to the recital of which I had paid so little attention) came on about the same length of time after my application of the acid and followed about the same course as that which I have just described. Dr. Frederick J. Schoenberger attended her in the first attack and also saw her during the second one, and found them in every way very similar. On the second occasion, thirty hours after she had visited my office, there was no evidence of abnormal irritation in or about the membrana tympani, the external auditory canal, the pharynx, or the buccal cavity.

Both Dr. Beck and Dr. Collins of the visiting staff, who were informed of the symptoms on the next day, pronounced it to be, in their judgment, a case of angio-neurotic œdema.

Dr. Joseph Collins (in the *Reference Handbook of the Medical Sciences*, William Wood & Co., 1893, vol. ix, p. 42) defines angio-neurotic œdema as "a vasomotor neurosis, characterized by the appearance of circumscribed swellings on various portions of the body, by preference the face, throat, and extremities, without apparent cause or premonition and non-inflammatory in character. . . ."

"Of the directly exciting causes, cold and traumatism are the most obvious. . . . The period in the twenty-four hours when attacks are most liable to show themselves is during the time between 1 and 5 A. M., when the tide of life is at its lowest ebb and the parts

are the least resistant." In the case under discussion the œdema arose somewhat earlier than this.

Dr. Collins, in the article above quoted, relates that, in a total of seventy-one cases collected, the swelling showed itself for the first time: in the face, in twenty-nine cases; in the larynx, in five; on the gums and palate, in one. In the remaining cases various other parts of the body were affected, but no mention is made of its occurrence in the tongue.

To quote further from Dr. Collins's article: "The nature of the lesion is unquestionably that of a non-inflammatory œdema circumscribed in form. . . . It is probable that, although the lesions or the irritants upon which the disease is dependent may attack the other parts of the system, yet the result directly appears through the sympathetic system of nerves. Furthermore, the nerves affected are undoubtedly the vasomotor nerves. The disease, in its development, has a close relation to other vasomotor neuroses, such as morbid blushing and flushing, exophthalmic goître, and many of the arthropathies as yet not well understood."

It seemed as if, in the present case, there must have been some connection between the application of the chromic acid and the œdema. Mrs. — had never experienced a similar attack before, nor did she have, so far as I could learn, any hereditary tendency to such attacks. The mere fact that on two separate occasions she manifested these peculiar phenomena, each time within fourteen hours after the chromic acid had been applied, could scarcely be interpreted as a mere coincidence. It certainly looked as if the two things were related to each other as cause and effect. But how to explain it? I never myself encountered anything of a

similar nature, and Dr. A. H. Buck, with whom I talked over the case, said that he also had never heard of a similar occurrence. I made a careful search through an index of otological literature covering a period of a number of years back from the present time, but I entirely failed to find a single report of anything resembling the present case.

The conclusion, however, seemed to be warranted that the œdema must in some way be due to the active stimulation of the chorda tympani nerve; and, although the text-books on physiology only speak of the symptoms which arise from electrical stimulation of the chorda tympani nerve, nevertheless it must be possible for such phenomena as are here under consideration to occur from the stronger stimulation supplied by an irritant like chromic acid. In answer to the question, Why did not the œdema manifest itself immediately after the application of the irritant? I may state that the nerve was doubtless surrounded by granulation tissue, and that consequently a considerable period of time might readily have elapsed before the acid (which, as is well known, spreads slowly through the living tissues) could exert its irritant effect upon the nerve. The first few applications, it may be assumed, gave rise to no œdema simply because the granulations were too exuberant at the time to permit the acid to penetrate the nerve filaments. But when we consider how frequently chromic acid is employed for the destruction of granulation tissue in this very neighborhood, it seems remarkable that phenomena of a similar character should not have occurred in the past and have been reported in medical literature. I might, as a matter of course, fall back upon the supposition that this particular pa-

tient possessed an idiosyncrasy as regards the effects of this drug; but this would not be, it seems to me, either a satisfactory or a scientific way of disposing of the question.

Although previous to the first attack she never had any similar œdema, yet very lately there has been a swelling of the left hand and of the ball of the left foot, but no glossal œdema. Undue mental excitement was the only cause to which I could attribute this last attack. The discharge from her ear, I might add, had in the meantime entirely ceased, and no evidence of active inflammation remained.

In the belief that they may be of interest to the reader of this paper I will introduce here, without comment, a few quotations from different authorities in regard to the functions of the chorda tympani nerve.

Foster, in his *Text-book on Physiology* (Macmillan and Company, New York, 1889, Book III, chapter v, p. 265), states that "The chorda tympani . . . ends partly on the tongue and partly in a small nerve which, leaving the lingual nerve before reaching the tongue, runs along the duct of the submaxillary gland, and is lost in the substance of the gland; a small branch is given to the sublingual gland." Again, in chapter v, page 265: "The chorda tympani contains afferent fibres which have a remarkable effect on the nutritive processes of the tongue, and the loss of taste due to the destruction of the chorda might be due to disordered nutrition of the tongue, and so be analogous to the loss of smell, which may follow injuries of the fifth nerve."

Dr. C. N. Stewart, in his *Manual of Physiology* (London, 1895, p. 129), states: "The best-known ex-

amples of vasodilator nerves are the chorda tympani and the nervi erigentes. The chorda tympani contains vasodilator and secretory fibres for the submaxillary and the sublingual glands. . . . A most marked vascular change is produced by stimulation of the peripheral end of the chorda tympani nerve: the glands flush red; more blood is evidently passing through their vessels. Allowed to escape from a divided vein, the blood is seen to be of a light arterial color and shows a distinct pulse. The small arteries have been dilated by the action of the vasomotor fibres in the nerve. . . . These vasodilator fibres are apparently not in constant action, for section of a nerve, as a rule, produces little or no change."

In Kirkes's *Handbook of Physiology* (American edition, William Wood and Company, 1896, p. 305 *et seq.*) the following statements are made: "The chorda . . . joins the lingual or gustatory nerve, proceeds with it for a short distance, and then passes along the duct of the submaxillary gland, to which it is distributed, giving branches to the submaxillary ganglion and sending others to terminate in the superficial muscles of the tongue. . . . If this nerve be exposed and divided anywhere in its course from its exit from the skull to the gland, the secretion, if the gland be in action, is arrested, and no stimulation either of the lingual or of the glosso-pharyngeal will produce a flow of saliva. But, if the peripheral end of the divided nerve be stimulated, an abundant secretion of saliva ensues, and the blood supply is enormously increased, the arteries being dilated. The veins even pulsate, and the blood contained within them is more arterial than venous in character.

“When, on the other hand, the stimulus is applied to the sympathetic filaments (mere division producing no apparent effect), the arteries contract and the blood stream is, in consequence, much diminished, and from the veins there escapes only a sluggish stream of dark blood. The saliva, instead of being abundant and watery, becomes scanty and tenacious. If both chorda tympani and sympathetic branches be divided, the gland, released from the nervous control, may secrete continuously and abundantly (paralytic secretion).

“The abundant secretion of saliva which follows stimulation of the chorda tympani is not merely the result of filtration of fluid from the blood-vessels, and in consequence of the largely increased circulation through them. This is proved by the fact that, when the main duct is obstructed, the pressure within may considerably exceed the blood pressure in the arteries, and also that when into the veins of the animal experimented upon some atropine has been previously injected, stimulation of the peripheral end of the divided chorda produces all the vascular effects as before, without any secretion of saliva accompanying them.

“Again, if an animal’s head be cutoff and the chorda be rapidly exposed and stimulated with an interrupted current, a secretion of saliva ensues for a short time, although the blood supply is necessarily absent.

“These experiments serve to prove that the chorda contains two sets of nerve fibres, one set (vasodilator) which, when stimulated, act upon a local vasomotor centre for regulating the blood supply, inhibiting its action, and causing the vessels to dilate, and so producing an increased supply of blood to the glands; while another set, which are paralyzed by injection of atropine,

directly stimulate the cells themselves to activity, whereby they secrete and discharge the constituent of the saliva which they produce. These latter fibres very possibly terminate in the salivary cells themselves. If, on the other hand, the sympathetic be divided, stimulation of the tongue by sapid substances, or of the trunk of the lingual, or of the glosso-pharyngeal, continues to produce a flow of saliva. From these experiments it is evident that the chorda tympani nerve is the principle nerve through which efferent impulses proceed from the centre to excite the secretion of this gland."

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