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A case of division of the auditory nerve for painful tinnitus

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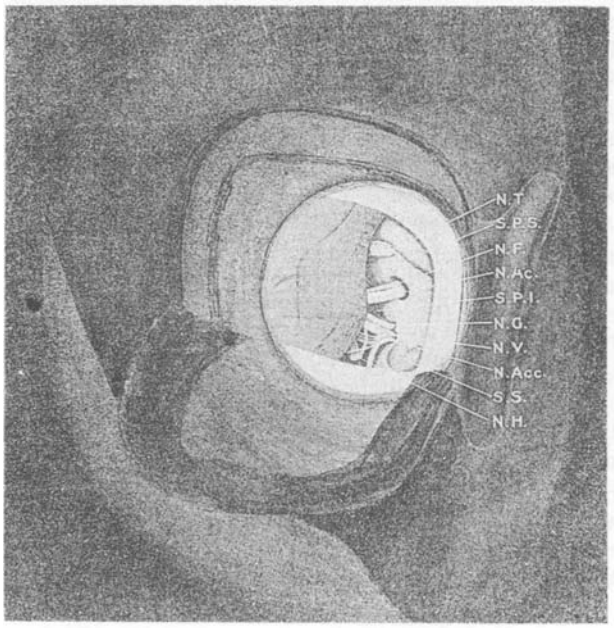
A woman, aged 49 years, was sent to me by Mr W. G. Sutcliffe of Margate on 14 November 1906. Her illness commenced suddenly in February, 1906, with buzzing tinnitus, vertigo and nausea, and on several subsequent occasions a similar attack occurred. After a time the tinnitus became continuous and was more and more often accompanied by giddiness. No benefit was derived from medical treatment nor from staying at Margate and the Isle of Wight. In September, 1906, the character of the tinnitus suddenly changed from a buzzing to a most distressing steaming or whistling noise which, at its height, became actually painful; the patient's own expression was 'the noise is the pain'. When I saw her on November 14, 1906, about ten months after the commencement of the illness, she complained of intolerable tinnitus in the right ear, occasionally accompanied by giddiness and nausea. She was in great distress and feared that if no relief could be given she would go mad and kill herself. The right ear was almost totally deaf; the watch and the voice were not heard at all and the tuning fork was scarcely perceived. The tympanic membrane looked normal. There were no signs of a gross intracranial lesion; the disease was clearly labyrinthine. I suggested division of the auditory nerve but advised the patient first to consult Dr D. Ferrier. I did not see her again until January, 1908, when she came to me with Dr Soden. In the interval she had been under Dr Ferrier, Dr Purves Stewart, Mr Lake, Mr Woods, and others. Many methods of treatment, including hypnotism and high-frequency currents, had been tried. In November, 1907, Mr Lake removed the semicircular canals of the affected side; this operation almost copletely relieved the patient from the vertigo but in no way affected the painful tinnitus. Facial palsy followed Mr Lake's operation but from this there were signs of commencing recovery. The general condition was not good; the patient was feeble, fat, and flabby, and the pulse, for some reason or another, varied from 100 to 120. I renewed my original suggestion that the auditory nerve should be divided and this was now agreed to by Dr Ferrier.

On 18 January 1908, bone was removed over the right cerebellar region and nine days later the operation was completed. The dura was opened and the cerebellar hemisphere displaced backwards and inwards by marine sponge pressure. On removing the sponges the cerebellum remained in the retracted position, so that the fifth, seventh, eighth, ninth, tenth, eleventh, and twelfth nerves were exposed to view (see figure). The eighth nerve was depressed so as to enable me to see clearly the rounded cord of the facial nerve and to avoid injuring it when dividing the auditory nerve. Then the division of the auditory nerve was easily accomplished. I made no attempt to separate the nerve of Wrisberg from the auditory nerve; indeed, I did not see it, no doubt because it was concealed by the arachnoid sheath. There was slight hæmorrhage from the auditory artery. On recovery from the anæsthetic there was conjugate deviation of the eyes to the left, and the eyes could not be moved towards the right. In about 48 hours this movement was again possible, but was feeble and was attended by lateral nystag-



DESCRIPTION OF ILLUSTRATION ON PAGE 1071

Figure illustrating the positions of the nerves exposed in the operation of division of the auditory nerve. (Reproduction of a photograph of a coloured drawing outlined at the time of operation.) The central portion of the operation area was brightly illuminated by an electric forehead lamp. The scalp and dural flaps are visible below this bright area and the cut edge of bone and scalp above. The cerebellum was displaced by dry sponge pressure. N.T., Nervus trigeminus (motor root on median aspect of sensory root, indicated by dotted lines). S.P.S., Sinus petrosus superior, N.F., Nervus facialis, N.AC, Nervus acusticus, S.P.I., Sinus petrosus inferior, N.G., Nervus glossopharyngeus, N.V., Nervus vagus, N.ACC., Nervus accessorius, S.S., Sinus sigmoideus; entering posterior compartment of foramen jugulare, N.H. Nervus hypoglossus.

mus with wide excusions. Convalescence was very slow, the pulse remained at 100, or over, for some weeks, and there was a little difficulty in swallowing due to paresis of the right side of the palate and of the right side of the pharynx. There were occasional syncopal attacks and also paroxysmal feelings of impending suffocation by which she was sometimes awakened at night. There was absolute deafness of the right ear. The facial palsy was not increased by the operation. On 13 March there was still slight paresis affecting the right side of the palate and pharynx. Nystagmus was still present. The optic discs were normal and the pupils were equal. The respirations were 22 and feeble. The pulse was 100 and regular. The heart was normal. There was neither anæsthesia nor ataxia. The plantar reflexes were flexor. I saw the patient again on 24 May. The scalp flap was concave. The painful tinnitus had ceased. There was still some weakness on the right side of the face. The tongue deviated very slightly to the left when protruded. There was nystagmus when looking to the right but less than formerly, and only slight jerks onlooking to the left. The palate, pharynx, and vocal cords moved normally and there was no longer any difficulty in breathing or in swallowing. The sense of taste was lost along the right side of the tongue. There was an area of deficient sensation (as tested with a camel's hair brush) of about the size of a split pea at the junction of the middle of the posterior border of the right external meatus with the concha. There was no affection of any other cranial nerve. The knee- and ankle-jerks were greater on the right than on the left side. The supinator jerks were equal. The pulse was 60. There were no indications of gross disease and no apparent reason why the patient should not get quite well.

Attempts to divide the auditory nerve have been previously made, but I am not aware that the operation I have just described was employed in any of them. It presented no difficulty; by the use of marine sponge pressure the nerves were clearly exposed and the view was not obscured by blood or cerebro-spinal fluid. I learnt this method from Dr Ferrier, who employed it with great success in his experiments on the monkey's brain. I think it could often be used with great advantage in preference to the metal retractor when we have to displace the brain in order to divide a cranial nerve or remove a deeply seated tumour, such as one situated in the cerebello-pontine angle or one growing from the pituitary body.

The operation of division of the auditory nerve is a means of relieving a patient from distressing tinnitus and vertigo not amenable to other measures. Such patients are almost invariably deaf on the affected side so that no sacrifice is made by cutting off the labyrinth from its connexion with the brain. The operation being undertaken for disease of the labyrinth or its ganglia does not give rise to that group of symptoms which follows division of the auditory nerve or extirpation of the labyrinth in animals so well described by Bechterew and Risien Russell. Mr Lake's skilful operation for removing the semicircular canals cannot be expected to relieve a painful tinnitus. Either the cochlear ganglion must be destroyed or the cochlear division of the auditory nerve divided.

Further successful cases would afford opportunities of correcting or confirming the views which have been expressed as to the course of the nerve fibres transmitting impulses of taste. Such opportunities would be of especial value since the sense of taste cannot be satisfactorily tested in the lower animals. At the operation several cranial nerves were so clearly exposed that I determined to recognize each one by stimulation. The fifth, seventh, ninth, tenth, eleventh and twelfth nerves were stimulated both mechanically and electrically. The muscles of mastication, supplied by the motor division of the fifth; the muscles of the face, supplied by the seventh; the sterno-mastoid and trapezius, supplied by the eleventh; and the muscles of the tongue, supplied by the twelfth; all contracted. The glosso-pharyngeal and the vagus were stimulated but the results were not observed as the larynx, pharynx, and palate were not seen. No alteration in the pulse-rate or in the respiratory movements was detected. The nerve of Wrisberg was divided with the auditory in the case here related, and the sense of taste was lost on the corresponding side of the tongue, not only in the anterior two-thirds but also in the posterior third, which is usually considered to depend upon the glosso-pharyngeal for its connexion with the brain. Should it be found possible to divide the auditory nerve without injury to the nerve of Wrisberg we should expect the sense of taste to remain unaffected.

It is well known that when the chorda tympani, or the facial trunk above the point where the chorda tympani is given off is paralyzed the sense of taste is lost on the anterior two-thirds of the tongue on the same side. In the complete mastoid operation the chorda tympani nerve can seldom escape injury and may be paralyzed by disease before the operation. I have tested the sense of taste in a few patients after their recovery from the mastoid operation and found that it was lost on the anterior two-thirds of the tongue. Unfortunately the sense of taste was not tested in my case prior to division of the auditory nerve and the nerve of Wrisberg. It must have been already lost on the anterior two-thirds of the tongue owing to the facial palsy, but there is no reason to suggest that it was lost on the posterior third of the tongue.

The facial nerve and the nerve of Wrisberg together form a mixed nerve comparable to a spinal nerve; the motor impulses pass by way of the facial and the sensory by way of the nerve of Wrisberg. The fibres connected with the unipolar cells of the geniculate ganglion, both proximally and distally, convey impulses towards the brain; the ganglion itself being the so-called ganglion of origin or trophic centre of the sensory root of the seventh nerve, just as the ganglion on a spinal root is the trophic centre of the sensory portion of a spinal nerve. The sensory portion contains special sense fibres from the taste organs of the tongue and trophic and sensory fibres from the skin of the external meatus and concha, but the precise extent of the peripheral area from which it transmits impulses is not yet defined. The anatomical course of the sensory division of the facial nerve, between the periphery and the geniculate ganglion, has not yet been traced, but the taste fibres pass from the periphery to the geniculate ganglion through the chorda tympani and through the glosso-pharyngeal nerve. The taste fibres in the glosso-pharyngeal nerve pass, probably *viâ* Jacobsen's nerve and the superficial petrosal nerves, to the geniculate ganglion.

The afferent fibres from the skin of the meatus and

auricle on their way to the geniculate ganglion may travel by one or other of several routes: (1) through the auriculo-temporal branch of the fifth *viâ* the otic ganglion and the small superficial petrosal nerve; (2) through the auricular branch of the vagus to the trunk of the facial; or (3) *viâ* the auricular branch of the vagus to the glosso-pharyngeal and thence *viâ* the nerve of Jacobson. Poirier describes the sensory nerve for the external auditory meatus (Arnold's nerve) with the branches of the facial, and points out that it presents considerable diversity in the arrangement of its connexions with other nerve trunks. Ordinarily it is connected with the vagus, but it is sometimes connected with the vagus and with the glosso-pharyngeal, and sometimes with the glosso-pharyngeal alone. Arnold's nerve is generally connected with the facial three or four millimetres above the stylo-mastoid foramen. Cunningham states that Arnold's nerve usually communicates with the facial nerve by a branch arising from the latter in the aqueduct of Fallopius. In rare instances Arnold's nerve is connected with the trunk of the glosso-pharyngeal below the ganglia. Cruveilhier, Richet, and Testut have seen a nerve pass directly from the base of the tongue and the soft palate to the facial at the stylo-mastoid foramen without joining the glosso-pharyngeal. This nerve may prove to be the nerve of taste from the posterior third of the tongue which ordinarily, but not always is, for part of its course, included in the sheath of the glosso-pharyngeal.

The sensory division of the facial conveys, in addition to taste impulses, impulses of common sensation from the skin of the posterior half of the external auditory meatus and part of the concha. On division of the sensory trunk of the fifth nerve behind the Gasserian ganglion the sensation of the external auditory meatus and of part of the concha remains normal. Ramsay Hunt, in an interesting communication in the *Journal of Nervous and Mental Disease* last year, points out that inflammation of the geniculate ganglion causes herpes within the auricle and external auditory canal. Inflammation spreading from the geniculate ganglion along the sheath of the facial nerve explains why facial palsy and various auditory symptoms sometimes accompany herpes auricularis. The 'Zoster zone' of the geniculate ganglion lies between that of the Gasserian ganglion and that of the second and third cervical ganglia.

The operation described in this paper brings the distressing symptoms induced by certain forms of internal ear disease within the control of surgery, in that such symptoms may be cured by division of the auditory nerve just as epileptiform tic in the territory of the fifth nerve is cured by dividing the nerve or removing the Gasserian ganglion. Just as in division of the trunk of the fifth nerve we may hope some day to be able to spare the motor root, which is in no way concerned in the disease, so in division of the auditory nerve we may hope to be able to spare the nerve of Wrisberg which is in no way concerned with auditory symptoms. Labyrinthine symptoms have their origin in the cochlear ganglion or in the vestibular ganglion or in both ganglia, but we cannot yet think of a method for separating surgically the cochlear and vestibular divisions of the auditory nerve so as to be able to spare the one or the other as the symptoms may indicate.

Harley-street, W.

Key words: Tinnitus; Neurectomy, vestibular; Cochlear.