

## XXIV.

### IMPAIRED HEARING FOLLOWING A PARALYSIS OF THE NERVUS ABDUCENS.

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From time to time reports have been made on paralysis of the sixth cranial nerve following or associated with disturbances of the ear, especially the middle ear by such men as Tomasi<sup>1</sup>, Poli<sup>2</sup>, Citteli<sup>3</sup>, Gradenigo<sup>4</sup>, Alt<sup>5</sup>, Noltenius<sup>6</sup>, Urbantschitsch<sup>7</sup>, Ostmann<sup>8</sup>, Dorello<sup>9</sup>, Blanc<sup>10</sup>, Mawthner<sup>11</sup>, Ruttin<sup>12</sup>, Tacques<sup>13</sup>, Török<sup>14</sup>, Schwartze<sup>15</sup>, Moos<sup>16</sup>, Habermann<sup>17</sup>, Hilgermann<sup>18</sup>, Högyes<sup>19</sup>, Bernheimer<sup>20</sup>, Knapp<sup>21</sup>, Baldenweck<sup>22</sup>, Rimini<sup>23</sup>, Maruyama<sup>24</sup>, Perkins<sup>25</sup>, Nagaoka<sup>26</sup>, Wheeler<sup>27</sup>, and others. Almost all cases in these reports had, from the beginning of the paralysis, more or less involvement of the middle ear or the structures which are closely related to it, such as, for example, the mastoid cells, the eustachian tube, cranial blood sinuses or the temporal bones.

From the review of the literature at our hands a case in which disturbance of hearing follows a paralysis of the sixth cranial nerve with no apparent focal infection, or any disease of the middle ear and its related structures, seems to be quite rare or else has not been observed.

The following is a case, we observed, in which impaired hearing and tinnitus followed in the course of paralysis of the abducens nerve.

H. T., age 42, male, married, railway man. According to the patient's statement, his father died from excessive use of alcohol; mother dead; cause unknown. Has one child who is living and well. Patient has always been well except that when twelve years old, he had measles and when eighteen he contracted a Neisserian infection. He denies syphilis.

Twelve years ago while he was playing a shot gun which he believed unloaded, accidentally went off burning his left cheek, and penetrating the left mandible. An incision was made into the cheek for the purpose of taking the lead out

of his mandible and he now has a large scar on the side of his face. Since that operation he has had trismus to some extent. There is no history of any disorder in his ear or nose in the past, as a result of the accident.

History of Present Complaint.—A few weeks ago, while working he noticed that he had diplopia, but complained of no other symptoms. This double vision became worse and in the week that he first noticed the diplopia, he visited our hospital and a diagnosis was made of a paralysis of the right abducens, in the eye clinic. His vision at that time in both eyes was 20/20, with no changes in the fundus oculi. No other motor nerves of the eye were involved. He has double vision when he looks either to the right or left, but it is more marked when he looks to the right. The patient is not able to move the right eye to the right at all.

In spite of all treatment in the eye clinic, thirteen days after his trouble started, he began to have severe pain, sometimes shooting in character in the temporal and mandibular parts of the right side of the face. At the same time he developed hard hearing, and intense tinnitus on the right side, which resembled the ringing of a bell.

With this history and complaint the patient was turned over to us by the eye men just two weeks after the beginning of his diplopia. The tinnitus increased, and sounded eventually to the patient like the note of a flute. There is no history of fever or vertigo. The pain, however, in the right parietal and frontal regions is associated with hyperesthesia, and when the finger is pressed over the supraorbital notch, or over the temporal fossa an exquisite pain is produced.

The man is of medium size with large bones, well nourished, pulse 65. The arteries show no sclerosis. On the left side of the face, he has a scar five centimeters long running across the angle of the mandible. The mandibular joints are passively movable, and it can easily be seen that his limited ability to open the mouth is due to cicatricial contraction of skin and muscles of mastication, and not due to any ankylosis of the mandibular joint.

The organs of the thorax and abdomen exhibit normal conditions. Sensibility and motility of extremities are good. Patellar reflex present and normal. Urine is negative.

Eyes: Conjunctivæ, cornæ, lacrimal sac, and iris are normal. Sight normal. Pupils equal, and react to light and accommodation. No pathological condition is present in the orbital cavity. The movement of the left eye is good, but the right is fixed with the eyeball turned toward the median line, and the patient has no ability to move the eye outward.

Nose: Some dry material is adherent to the mucous membrane but gives no odor and is no doubt just the remains of the natural secretion. The accessory nasal sinuses are not tender or inflamed.

The muscles supplied by the facial nerve show no paralysis. A slight catarrh of the mouth is present. Stenson's ducts are patent on both sides, even on the left, in spite of the cicatricial tissue. At a point just beneath the zygomatic arch, immediately in front of the mandibular joint, he is tender to pressure.

Ear: Examination of middle ear and its surrounding structures exhibits no pathologic conditions, but are entirely normal, except that both tympanic membranes are retracted inward and somewhat thickened and opaque. The mastoid processes are not tender, and there is no trace of an old mastoiditis. Griesinger's and Gerhardt's signs negative. The nerves which pass through the jugular foramen show no paralytic conditions. No symptoms are present which could arise from an involvement of the transverse or cavernous sinuses or jugular vein. Air could easily be blown into the eustachian tube, and there followed no effects of disturbed hearing or tinnitus. When one passes the finger under pressure up or down along the carotid artery on the side corresponding to that of the abducens paralysis there results no change in the quality of the tinnitus above which he has always complained of during the last few days.

The functional hearing test revealed the following findings: The Weber test is given on the uninvolved side, while Schwabach test is decidedly shortened in the involved ear, but normal in the left. Rinné is negative on the right. The tuning forks give negative results with  $C_3$ ,  $C_4$ ,  $Fis_4$  in the right ear, while the others, of lower vibrations, could be heard. The left ear is normal in reference to all the tuning fork vibrations. On the right side, he is completely unable to hear a watch.

Examination of the vestibular apparatus: There is no spontaneous nystagmus. Romberg sign is negative, i. e., no coördination disturbances are present when the patient stands with his eye open or closed. The rotation and the caloric tests exhibited nothing abnormal.

From the above results of the examinations of the functions of the ear, we can conclude that the seat of the disorder in this patient is not located in the sound conduction apparatus, but either in the cochlea or most likely some place along the cochlear nerve.

Nothing is revealed by a roentgenogram of the head except that on the border line of the superior angle of the pyramid of the right temporal bone there is a light shadow somewhat enlarged so that the upper border of the pyramid does not appear as sharp as it does on the left side.

With the examination thus far conducted we were unable to reach a diagnosis, but when a Wassermann was made it was found to be three plus.

Then when energetic antiluetic treatment was instituted, consisting of mercurial inunctions, potassium iodid and two injections of neosalvarsan, there was a prompt improvement. Indeed, after sixteen days of this treatment the tinnitus and the pain in the right side of the face and head totally disappeared. The movement of the right eye became free, although not perfect, and the patient no longer complained of double vision when he looked towards the left. The results of the hearing tests were also better. Weber lateralized to the left side, Rinné positive on both sides, shortening of Schwabach has disappeared, and now is normal on each side. Tuning forks A, C, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, Fis<sub>4</sub> could all be heard on the right side. Watch: Left 200/200 centimeters; Right 10/200 centimeters.

Further, after 56 days from the outset of the disease, that is, 35 days after the beginning of antiluetic treatment, the patient recovered his hearing completely as the repeated tests showed. A watch could be heard at the same distance from the right side as from the left. There remained, however, a lateralization of the Weber to the left. The diplopia is almost entirely absent, being only present when looking to the extreme right.

From the above case we may conclude that the inability to hear high pitched vibrations, and tinnitus with the hyperesthesia and shooting pains in the course of a paralysis of the sixth cranial nerve of one side only. Since the Wassermann was strongly positive, and since there was a prompt disappearance of all the symptoms associated with the three nerves, abducens, cochlear and trigeminal, as soon as antiluetic treatment was instituted, we can only conclude that his condition was syphilitic. Indeed, it is known that paralysis of the abducens nerve as a result of syphilis is not rare<sup>30, 31, 32</sup>.

It may now be interesting to go here, into the location of the lesion which occurred in this case. The exact localization will of course be difficult, owing to the fact that the subject did not come to autopsy. So far as we can deduce, however, from the several observations made: the figures of paralysis, healing processes, relationship of each involved nerve, the characters of the disturbances in hearing, and other symptoms, as well as from anatomic relations on the one hand, and references on the other, a probable diagnosis may be established.

As it is known, the abducens nerve has a cortical center supposedly in the cortex of the gyrus angularis<sup>20, 31</sup>, and from there fibers are said to go down anteriorly to the aqueductus Sylvii, and to enter the nuclei in the pons, one portion decussating, while the other remains on the same side. The nucleus of the sixth nerve is located in the floor of the fourth ventricle, near the colliculus facialis closely surrounded by the fibers of the seventh nerve. Just lateral, and ventral and also anteriorly to the abducens nucleus, we have the motor fifth nucleus; while the sensory center of the fifth nerve is still more lateral and ventral and runs posteriorly into the cord as the tractus spinalis nervi trigemini. The second neuron of the abducens nerve arising in its nucleus, passes ventrally and leaves the brain stem at the ventral border of the pons. It then passes through the dura mater just behind the tip of the petrous portion of the temporal bone, and then enters the lateral wall of the cavernous sinus together with the ophthalmic division of the fifth, the trochlear, and oculomotor nerves, and finally reaches the orbital cavity to be distributed to the external rectus muscle.

Thus we see that the nucleus of the abducens nerve is located at some distance from the sensory trigeminal center, and from the nuclei cochleares. On the other hand, at the place where the abducens nerve perforates the dura, just behind the tip of the petrous pyramid, the nervus trigeminus and acustico-facialis are closely located.

If we consider the paralysis of the nervus abducens as a result of a middle ear affection, as is often done, we immediately come to a conclusion that this cannot be, for there was no involvement of the middle ear and its surrounding structures, as was shown by the examination of the mastoid cells, eustachian tube, cranial blood sinuses, and internal ear.

The lesion may, possibly, be located within the internal auditory meatus. The acoustic nerve here runs with the facial and since the latter showed no changes, it is hardly possible that the lesion is here, but must be some other place more centrally.

On the other hand, the lesion is not on the peripheral end of the abducens, as for example, in the muscles of the orbital cavity, or cavernous sinus, for there are no symptoms which could lead one to such a conclusion. If it were in the orbital cavity, it would necessarily show other symptoms than those observed. It may, however, be in the cavernous sinus, but the oculomotor or trochlear nerves exhibit no involvement.

We may now exclude the possibility of the seat of the lesion as being either in the orbital cavity, or cavernous sinus, or even any place peripheral to the internal auditory meatus on the path of the acoustic nerve, and must seek it some place immediately about the brain. An affection of the cortical center of the n. acusticus is hardly thought of in this case; first, because of the rarity of such a lesion, and second, because the center on one side gives origin to nerve fibers which go to both sides. This immediately disposes of such a lesion, for the patient had only trouble on one side. In the same way, we can dispose of a lesion about the cortical center of the abducens from an anatomic point of view and from Bernheimer's experiment<sup>20</sup> which proves that stimulation of the center on one side causes a response in both eyeballs.

As for the nuclear paralysis of the abducens in the brain stem, Hirsch<sup>24</sup> reports that in ninety per cent of the pons

affections, one sided paralysis of the abducens is associated with paralysis of the internal rectus on the opposite side. Forster<sup>37</sup> says that when there is a lesion in the floor of the fourth ventricle involving the sixth nucleus there is usually present facial paralysis owing to the close relationship of the sixth nucleus with that of the seventh. The arguments of these authors lead one to believe that the affection of the abducens is peripheral to its nucleus. Of course, it is not easy to differentiate the nuclear affections from those lesions along the course of the nerve, especially only from the symptoms. The lesion may be in the nucleus or along the course of the intracranial fibers of the abducens. We cannot exclude these possibilities all together. However, if we consider the other two nerves, that is, the acoustic and trigeminal, we know that the lesion is some place where these three nerves are close together; for it is hardly possible that an isolated lesion could be on each of these three nerves independently.

The lesion then, in all probability is on the posterior surface of the petrous portion of the temporal bone, where these three nerves leave the brain stem and pass through the dura mater, and this conclusion is further borne out, when we remember that the meninges about the base of the brain are frequent locations for syphilis.

#### SUMMARY.

1. The subject had hearing disturbances of high pitched sounds, tinnitus of high character, and hyperesthesia in the region of distribution of the trigeminal nerve, in the course of an abducens paralysis, all occurring on the same side, and in a little less time than two weeks.
2. Accurate examinations of the middle ear and its related structures and the internal ear showed normal condition.
3. All symptoms from the abducens, trigeminal and cochlear nerves must have been caused by the syphilitic affection.
4. The localization of the lesion in this case may be supposed to be in the meninges behind the petrous portion of the temporal bone, and involving those portions which are pierced by these three nerves.

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