DISEASES OF THE LABYRINTH WITH SPECIAL REFERENCE TO THE FISTULA SYMPTOM.*

BY FRANK R. SPENCER, M. D., BOULDER, COLORADO.

A brief review of the physiology of the semi-circular canals may not be out of place before considering diseases of the labyrinth, especially since it has been only a few years since this branch of otology has been well understood. While in Vienna last year, I had an opportunity to study the internal ear and to see cases illustrating the different forms of labyrinthitis. The cases mentioned later in this paper were seen there and not in private practice.

According to Ewald's law, "The movement of the endolymph from the smooth end toward the ampulla is the more effective movement in the external or horizontal semi-circular canal and produces nystagmus to the same side." Conversely stated, the movement of the endolymph from the ampulla toward the smooth end is the less effective movement and produces nystagmus to the opposite side. If we consider the superior or frontal semi-circular canal and the posterior or sagittal, the law must be reversed.

With Ewald's law in mind we have at least the four following methods of testing the reaction of the labyrinth: The turning test, the caloric test, the fistula test and the galvanic test. The turning test has the advantage of testing both ears at the same time while its disadvantage is that each ear cannot be tested separately. However, if one labyrinth is more irritable than the other, the more irritable one determines the direction of the nystagmus. In case one labyrinth has been destroyed by disease or by an operation we are able to test only the remaining internal ear by turning. With the caloric and galvanic we may test either ear separately or both together.

Bárány has demonstrated that turning either to the right or to the left ten times produces the best reaction.¹ If we turn a person with normal ears ten times to the right and stop, he should have, immediately after the turning, a horizontal nystagmus to the left for fifteen to thirty seconds—that is, the quick component should be directed to the left. Conversely, after turning to the left ten times and stopping there should be a horizontal nystagmus to the right for fifteen to thirty seconds if the head has been held up-right. The superior canal may be tested in a similar manner if the patient inclines his head forward during the turning and the pos-

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terior if he inclines his head backward. The last two canals produce, of course, a rotatory nystagmus.

The caloric test may be made with hot or cold water if the drums are intact or if suppuration is present. If there is a perforation and an absence of pus, hot and cold compressed air may be used in order to avoid moisture. Syringing with cold water normally gives nystagmus to the opposite side and with hot water to the same side. Cold water is usually more agreeable to the patient and should be about 25° C. Hot water should be about 48° C.

The test for a fistula can be made by either compression or aspiration. A fistula is usually located in the bony portion of the horizontal or external auditory meatus, as this is the most exposed of all the semi-circular canals to middle-ear suppurations. However, it may be in the cochlea, vestibule or one of the other semi-circular canals. Ruttin states that forty out of fifty cases in which a fistula was demonstrated, compression of air in the external auditory meatus and middle-ear produced nystagmus to the same side and aspiration produced nystagmus to the opposite side. In other words, this is the typical reaction of the labyrinth to condensation and rarefaction of air in the middle-ear and is the rule. This shows that the endolymph is driven by compression from the smooth end toward the ampulla, which is the more effective movement for the horizontal semi-circular canal.

The three tests just given all act on the endolymph in the labyrinth while the galvanic test determines the reaction of the eighth nerve. If we place the cathode in the right meatus we should expect a nystagmus to the right, and if we place the anode in the right meatus we should expect nystagmus to the left if the auditory nerve is normal. The test does not depend upon an intact labyrinth, as it may be used soon after the labyrinth has been destroyed by either disease or an operation. We may begin the test with four milliamperes of the galvanic current, but as much as eight to fifteen may be required before the nerve responds. If the nerve has been destroyed or is atrophic it will, of course, not respond.

Three degrees of spontaneous nystagmus are recognized: 1. Spontaneous nystagmus when the patient looks in the direction of the quick component, but which is absent when the patient looks either straight ahead or in the direction of the slow component. 2. Spontaneous nystagmus is present when the patient looks straight ahead, but is increased by looking in the direction of the quick component. The nystagmus disappears, of course, upon looking in the direction of the slow component. 3. The third de-

gree is present in all positions of the eyes, but is greatest when the patient looks in the direction of the quick component and is least when the patient looks in the direction of the slow component. Sudden destruction of one labyrinth always produces third degree nystagmus with the quick component directed away from the diseased ear. The slow component is the peripheral one and comes from the labyrinth while the quick component is always central. For instance, if we syringe the ear of an unconscious patient we produce only the slow component, as the central or quick movement of the eyes is absent. The eyes move in the direction of the slow component and remain in that position as long as the syringing is continued. Inflammations and suppurations of one side produce a nystagmus to the opposite side for from three to fourteen days.

The finger test can be made after syringing the ear. After cold syringing the patient falls toward the syringed ear if asked to stand erect with the eyes closed and misses the finger of the physician by passing his finger to the left of the observer if the left ear was the one syringed.

Ruttin gives the following table or classification of the different forms of labyrinthitis: 1. Cases of circumscribed serous labyrinthitis give a history of labyrinthian symptoms during the attacks. There is usually horizontal and rotatory nystagmus to the opposite side, but the nystagmus may be directed to the same side. Hearing is present; the fistula symptom is present and the labyrinth reacts to the caloric tests. 2. Cases of diffuse serous labyrinthitis do not give any history of labyrinthian symptoms during the course of the middle-ear disease. Third degree nystagmus is present with the quick component directed toward the affected side usually, though it may be directed toward the same side in mild cases. Hearing is usually absent, but it may be present. The ear usually reacts to the caloric test, but there may be a total absence of any reaction to this test. The fistula symptom is usually absent, but is present in those cases in which the diffuse serous labyrinthitis was preceded by a circumscribed serous labyrinthitis. 3. Cases of acute purulent diffuse labyrinthitis do not give any history of labyrinthian symptoms during the attack of middle-ear disease. Third degree nystagmus is present with the quick component directed toward the opposite side. The hearing, the caloric reaction and the fistula symptom are all absent. 4. Cases of diffuse purulent labyrinthitis give a history of labyrinthian symptoms during the attack. Spontaneous nystagmus is often absent, but may be present. The hearing, the caloric reaction and the fistula symptom are all absent. The first two types of labyrinthitis demand only a

radical mastoid operation while the third and fourth types demand a radical operation and an operation upon the labyrinth too.

Case 1: Mr. A., aged 25, examined June 29, had a radical mastoid operation on the right side, May 27, with an uninterrupted recovery. For the past few days he has had a severe vertigo, and the fistula symptom was found to be present upon examination. Compression produced nystagmus to the same side and aspiration to the opposite side. Examination of the eyes shows a spontaneous nystagmus with the quick component directed to the right when the eyes are turned to the right. The nystagmus was made stronger by moving the head, which shows that he is not a malingerer. He shows a slight nystagmus to the right after syringing, but does not fall in the direction of the slow component to the left, as we would expect. This latter test was made ten minutes after the syringing, so that it is not as valuable as if made immediately after the syringing.

Examination of the patient's hearing shows the following:—The patient hears a conversational voice at one-half meter with the right ear; Weber's and Rinne's tests were negative; bone-conduction slightly shortened. The upper tone-limit was below normal and the lower tone-limit was elevated. Turning the patient to the left ten times produced nystagmus to the right which lasted thirty seconds. Turning to the right ten times produced nystagmus to the left for twenty-seven seconds. Syringing the right ear with cold water gave nystagmus to the left. Diagnosis:—Diffuse serous labyrinthitis following circumscribed serous labyrinthitis. As he has had a radical mastoid operation he does not need any operation, but he should be watched to see if a purulent labyrinthitis develops.

There are three types of serous labyrinthitis so far as the hearing is concerned: 1. Cases with good hearing. 2. Cases with poor hearing. 3. Intermediate types with only a moderate degree of hearing.

Case 2: Mr. B., aged 18, right ear normal. History of left ear is as follows: Eleven years ago he had a Stacke radical mastoid operation on the left side. After the operation the discharge ceased. One year ago the left ear began to discharge again, but he has not had any headache, vertigo, or vomiting. Examination of the left ear shows the following: Hears a conversational voice at one and one-half meters; Weber's and Rinne's tests negative. The lower tone-limit is elevated and the upper tone-limit is below normal. By Schwabach's test the bone-conduction is not shortened. Caloric reaction present. Polypi and granulations present in the

antrum. Turning to the right ten times produced nystagmus to the left for fifteen seconds; turning to the left ten times produced nystagmus to the right for thirty seconds. Upon testing for the fistula symptom the patient showed nystagmus to the same side with compression and to the opposite side upon aspiration. Diagnosis:—Circumscribed serous labyrinthitis of the left ear. A radical mastoid operation is indicated. The prognosis should be guarded, as there is some danger of a purulent labyrinthitis following the radical exenteration.

Case 3: Mr. C., aged 34, gives a history of chronic purulent otitis media of the right ear for the past seven years, which followed influenza. One year ago the left ear began to discharge. The patient complains of headache, vertigo, nausea, and vomiting recently. Examination of the left membrana tympani showed a dry perforation in the posterior superior quadrant leading into the antrum. Examination of the hearing showed the following:—Conversational voice heard at one-quarter meter with the right ear and at two meters with the left ear; by Weber's test the fork was heard better in the left ear; Rinne negative for both ears. The lower limit was slightly above normal and the upper limit was normal. Spontaneous nystagmus was absent. The fistula symptom was present in the left ear with nystagmus to the left by compression and to the right by aspiration. Turning to the right ten times gave nystagmus to the left for thirty seconds; turning to the left ten times gave nystagmus to the right for thirty-one seconds which was normal for both labyrinths. As the vertigo in this case came on only fourteen days ago and since his hearing is as good as before, he has only a fistula without any disease of the membranous labyrinth. Diagnosis:—Circumscribed serous labyrinthitis. In this case only a radical is indicated, although we may treat this patient for a while, as the fistula may close without an operation. If the patient is not treated he is almost sure to have a purulent labyrinthitis.

In conclusion, I wish to emphasize the importance of making the test for the fistula symptom, because it yields, when present, valuable information and because it is an easy test to make. If present in any case of chronic purulent otitis media we are almost certain to find a cholesteatoma in the middle-ear and the antrum as the etiologic factor in producing the erosion of the outer bony labyrinth.

BIBLIOGRAPHY.

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