VESTIBULAR TESTS

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The standardization of vestibular examination is still far from being accomplished in spite of various efferts of the pioneers in this field who are still with us. Not only are there many schools of thought but almost every individual examiner employs different methods to perform the test.

Considering these facts, one of the greatest hindrances to proper standardization of the test can be found in the fact that there are numerous to perform the vestibular examination which are very difficult for the examiner, the novice in particular, to carry out in his office. I should like to emphasize that in order to standardize and to simplify the methods of vestibular examination, as a clinlcal test, the first requirement should be to select, as far as possible, simple and reliable methods which may be performed even in the physician's office.

It has been recognized in our country that from a practical point of view the standardization of the vestibular examination is necessary, and the Vestibuar Labyrinth Study Group was organized by us a few years ago.

Last fall, following the meeting of this Study Group, Dr. Morimoto, President of this Society, and Chairman of our Study Group, asked me to present a paper about vestibular test at this symposium. It is not the object of this paper to present a review of the vestibular test methods being used only in the experimental laboratory rather than in the hospital ward and doctor's office at the present time. It is of importance to stress that vestibular tests, as a clinical test, should be an indispensable and essential diagnostic means to be placed at the disposal of the practitioner. The present paper describes the simple and reliable technics of vestibular tests which may be carried out even in the doctor's office clinically.

1. Caloric tests.

Since Bárány's observations resulted in his development of the so-called caloric test, there are numerous methods used for caloric stimulation of the labyrinth. The advantage of the caloric test lies in the fact that each labyrinth can be tested separately, while in the turning test the two labyrinths are always stimulated together. Consequently, we prefer the caloric method in order to make a comparison between both labyrinths.

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It is important for each examiner to choose a method which is as simple as possible and which he can reproduce as exactly as possible from patient to patient so that the results of each test are, for practical purposes, comparable with others. For this purpose, we always employ ice water, cold air and bilateral calorization methods.

Ice water method:

To standardize the caloric test, the temperature of the water must be recorded, but a thermometer is not always available. The simpler the test the more readily it will be performed and less likely is it to be postponed. The following simple technic can be readily applied. Ice water is used as the stimulating fluid because it has a constant temperature. We have found it convenient to use 3 c.c. of ice water kept in contact with the eardrum for 20 sec. for stimulation of the labyrinth. The water is best introduced into the ear canal by means of a suitable syring with a needle, which is readily available in every hospital ward and every doctor's office. The ice water should be introduced under vision to assure that it reaches the ear drum without any perforation.

The position of the head during the caloric test should always be constant. If the head is tipped 30 degrees forward from the erect position the anterior vertical canal lies in the vertical plane. Similarly, if the head is tilted backward 60 degrees from the erect position this brings the horizontal canal into the vertical plane. The introduction of the solution should be timed with a stop watch. At the end of 20 sec. the solution should be decanted from the ear canal.

For practical purposes, the effect upon the horizontal canal is observed. The time of the nystagmus is recorded as from the beginning of stimulation to the disapperance of the nystagmus. Usually with the type of stimulation already mentioned, this lasts from 2 to 2.5 minutes in the normal person. In describing the results of the test, one should have some way of grading the amount of nystagmus. As a matter of convenience in our clinic we have chosen three grades. Grade 1 indicates that the amount of nystagmus is slightly less than normal; grade 2 indicates that the nystagmus is about average; grade 3 indicates that the nystagmus is associated with nausea and vomiting. Special glasses may be used to make the nystagmus more clear and to eliminate fixation but these are not ordinarily used in doing a caloric test.

If one is examining a patient with obvious vestibular irritation, smaller stimuli may be used, as little as 1 or 0.5 c.c. of ice water. On the other hand, if one does not get a reaction with the standard amount of ice water, one may increase the amount and lenghten the time of the stimulation. If an ear is markedly hypoirritable, it may only react to 30 c.c. of ice water introduced into the ear canal over the period of 60 sec. If one can not get any reaction with the latter amount of stimulation, one may suspect the presence of a dead labyrinth. It should be kept in

mind that before making such a diagnosis the test should be repeated on one or more occasions.

Cold air stimulation:

It is an accepted principle in otology that if there is a perforation of the eardrum any type of solution should not be inserted in the ear canal for a caloric test because of the danger of setting up a recurrence of discharge. Even if the solution is sterile, infection of the middle ear may occur. In such a case with drum perforation one can stimulate the labyrinth with cold air. A number of years ago Sir James Dundas Grant devised for this purpose an instrument which bears his name. Recently we modified his instrument in order to measure the temperature of cold air exactly.

Our instrument consists of a simple coiled mesh. If ethyl chloride is sprayed upon the cloth, the air in the tube is cooled, which is measured by a small thermometer fixed on the end of the tube. The bore of the coiled tube at the input end can be enlarged to connect with a double balloon which is in general use for air sprays. The output end of the tube is covered with an ear speculum which reduces the discomfort of the tube in the ear canal. I believe that the cold air method has many advantages over the use of cold water. It is readily available and it can be used not only in cases with drum perforation but in cases with a normal and intact ear drum.

According to Dr. McNally, if compressed air is used and if the air is directed against the ear drum through the ear speculum under vision, 20 sec. of cold air douching is a stimulus equivalent to 3 c.c. of ice water for 20 seconds and with the head back 90 degrees it elicits from the horizontal canal a nystagmus lasting from 2 to 2.5 minutes from the onset of the stimulation.

In our studies carried out by means of our instrument, 15 sec. of cold air douching elicits a nustagmus lasting from 150 to 80 sec. (latent 30–12 sec.), and 30 sec. of douching obtains a nystagmus lasting from 132 to 100 sec. (latent 30–12 sec.) in normal persons. It is more comfortable as far as the patient is concerned as it is easily repeated if necessary. I believe that the cold air method is recommended to the busy otologist because of its simplicity, safety, and relative accuracy.

Bilateral calorization:

It has always been recognized that bilateral calorization represents an exact method for disclosing slight differences in the excitability of the two labyrinths, even in cases where the unilateral method has failed. For the bilateral calorization, an instrument modified by Tawara, my coworker, is used in our clinic. The two rubber hoses are connected by a Y shaped glass tube. From the third end of the glass a rubber hose connects with a tank which is available to keep the water constant in temperature and in pressure.

Care must be taken to prevent technical errors. Under control of the vision, the

two taps should be inserted in corresponding parts of the each ear canal. Sometimes it may happen that after one tap is focused, efforts to focus the other brings the first out of the correct position. Therefore, before applying stimulus, I used to check up on the position of the taps. The patient lies comfortablly on the couth with his head raised 30 degrees above the horizontal. This brings the external semicircular canal into a position of maximum sensitivity to thermic stimulus. Tap water is allowed to flow into the each ear canal for 6 minutes. The flow must be free without causing discomfort. In practice the quantity of the water is 1500 c.c. in each side.

In our experiences, with stimulation of 10° c. of water vertical nystagmus towards the forehead was elicited in 100 per cent of a series of 171 normal persons, while with 20° c. of water we observed vertical nystagmus in 89.1 per cent of the total and with 30° c. of water the same nystagmus was obtained in 18.1 per cent of the total. In cases of vestibular lesion, horizontal nystagmus towards the side of hypofunction of the labyrinth was found in 50 per cent of 124 cases with stimulation of 10° c. of water, while no nystagmus is 39 per cent of the total 124 cases and vertical nystagmus towards the forehead in 11 per cent of the total was observed.

2. Galvanic test.

The galvanic test has not been used routinely in the average ear clinic particularly in our country. In this test the stimulating effects of the current are not limited to the labyrinth but may also reach the vestibular nerve and its nuclei in the brain stem. This test is used to differentiate diseases of the labyrinth from affections of the vestibular nerve (retrolabyrinthine lesions). Therefore the test is indicated in a case in which the labyrinthine excitability under caloric, mechanic, and rotatory stimulation is absent, so that it becomes important to know whether or not the galvanic reaction can be elicited. A positive response shows a labyrinthine lesion, whereas a negative reaction indicates the possibility of a retrolabyrinthine lesion. Recently the test has become of more interest to the otolaryngologist because of increasing reports of streptomycin damages.

Clinically we use a bipolar method, that is, two bulbar electrodes are placed on the mastoids so that the electric current is sent through the head. The galvanic nystagmus toward the cathode occurs at 2 to 5 milliampers. Although almost all patients feel uncomfortable even with such small currents, we observe a tendency to fall, tested in Mann's position, walking, and past pointing of the arms by means of writing method, which is introduced by an application of 0.6 miliampers. In this way the usually normal person indicates a tendency to fall towards the cathode.

3. The tilt test (Goniometer test).

The idea of slowly tilting the patient out of the horizontal plane as a means of determining utricular function was first suggested as a clinical test by Jones and Fischer and by Grahe. The rapid tilt test was introduced into the laboratory by

Ewald and Thomas. It was first suggested as a clinical test by Tait and McNally. This test is primarily a test of vertical semicircular canal function, but it is also a test for second mode utricular stimulation. For this test McNally used a tilt-table on which the patient is placed on kness and outspread hands. If, when the patient is tilted, there is an absence of protective reaction to the tilt, or if patient tends to be thrown in the direction of the tilt, this indicates a lesion of the vertical semicircular canals on the side to wards which the patient is tilted. If, on the other hand, there is a tendency for the patient to resist the tilting and overcompensate, this would indicate a lesion of the utricles, the vertical canals being intact. Recently for this test we devised an electric goniometer (Fig. 1). Plank (P) moved by electric

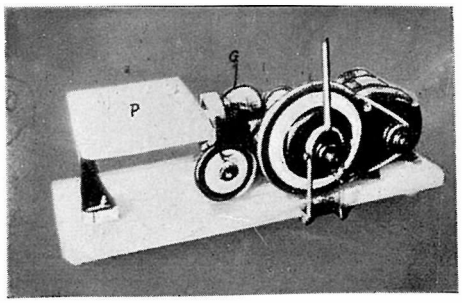

Fig. 1. Electric goniometer (Honjo).

driving gears (G) is tilted at six speeds of 1, 3, 5, 10, 15, and 20 degrees/sec. the subject standing on the horizontal plank of the goniometer is tilted forward, backward, and to both sides. During the tilting the subject keeps his eyes open or closed. The results obtained are embodied in a graph called a goniogram.

The goniogram of the cases with vestibular lesion is classified into three types based upon the curves obtained with open eyes and closed eyes. Type I shows a slight impairment which is often overlooked by other vestibular function tests. This impairment is not recognizable until the patients with closed eyes are tested at low speeds of tilting such as 1°, 3°, and 5°/sec. Type II includes those patients in whom vestibular dysfunction appeared only when they close the eyes. Type III shows both curves with open and closed eyes dropped at every speed and includes cases of severe disturbed vestibular function.