

diagnosis of acute appendicitis without perforation was made and patient persuaded to have an immediate operation. He came in during a clinic and one-half hour afterward was on the operating table.

Operation.—Nov. 8, 1902. Usual appendiceal incision through outer border of right rectus muscle, into peritoneal cavity. To our great surprise, on incising the peritoneum, it was found full of free pus with some gas. Examination revealed a perforation of the appendix. The perforation had been capped with the omentum, but through some accident on the night preceding his admission the cap was partially torn from opening and the contents had escaped into the peritoneal cavity. The probe could be inserted into the lumen of the appendix; the peritoneum was not "blistered," and its gloss was not seriously disturbed. The lower half of the abdominal and pelvic cavities contained large quantities of pus. Appendix was amputated; two large drainage tubes were inserted into pelvis. With each inspiration pus welled out of the tubes.

Patient was returned to his room at 1:15 and placed in bed in semi-sitting position, at angle of 35 degrees. Pulse 104 when he recovered consciousness. He vomited small quantity of greenish fluid, was restless and complained of pain in wound. At 6 p. m. pulse was 78 and temperature 99.4. At this time he was given $\frac{1}{2}$ gr. calomel and the dose was repeated at one-half hour intervals until 3 grains were given. At 6, 8 and 12 p. m. anti-streptococcus serum was given hypodermically in doses of 10 c.c. He slept some during the night, vomited once after taking 3ii mag. sulph., and at 4 a. m. was given a high rectal enema, which produced a free bowel movement. 300 c.c. of urine was passed.

November 9, a. m., temperature 99.4, pulse 92; p. m., temperature 100.6, pulse 108. Nuclein solution M. 20 was ordered every four hours, and inunctions of ung. Cr  d   gr. 45, daily. Towards evening patient was restless and slightly delirious. November 10, a. m., temperature 98.8, pulse 88. Good bowel movement followed high enema. Still quite restless and slightly delirious at times. Complains of some pain. P. m., temperature 99.2, pulse 90. Calomel was given in divided doses, followed by mag. citrate,   . Bowels moved twice. Wound was dressed and moderate amount of discharge found on dressing. November 11, a. m., temperature 99, pulse 76. Patient resting much more comfortably and bowels moved freely. P. m., temperature 100, pulse 84.

November 12, a. m., temperature 98.6, pulse 82; p. m., temperature 99, pulse 82. From this date until November 20 temperature ranged from 99 in the morning to 101 in the afternoon. On November 20 it reached normal in the afternoon and remained there until his discharge from the hospital. The drainage tubes were kept in for ten days, the tube being gradually shortened and diminished in size from time to time as the discharge lessened in amount. Dressings soaked in a saturated solution of sod. bicarb. were applied to the wound when the discharge was profuse to overcome the offensive odor, which persisted for six or eight days. Patient left the hospital December 6 cured.

This case illustrates forcibly what I have taught for years: That there is little or no depression immediately after perforation of the intestine and no collapse. In other words, collapse is a late manifestation and is the expression of the "blistering" of the peritoneum and absorption of the products of infection.

In this patient's case absorption did not have time to occur, as he was operated on ten hours after perforation took place. It will be noted that this patient was walking about the street with his physician, with his abdomen full of pus and a direct opening from his appendix into the free peritoneal cavity. Neither did I suspect the condition when I examined him before the operation.

No Medical Advertisements to the Laity.—A peculiar provision of Spanish law is that pharmacists are prohibited from advertising medicines or remedies in any papers but journals of medicine, surgery or pharmacy.

FUNCTIONAL TESTS OF HEARING: SOME OF THE PRINCIPLES ON WHICH THEY ARE BASED.*

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The object of this paper is to call attention to the value of some of the functional tests of hearing and to the principles on which they are based. Wm. H. Thompson has recently made the significant statement that a knowledge of diseases of the ear is of more value to the general practitioner than that of all the other special senses put together. This being true, a knowledge of the more accurate methods of diagnosis and prognosis becomes a question of prime importance. The functional tests of hearing are of greatest value in that large and oftentimes perplexing group of diseases of the non-suppurative type which affect the middle ear and labyrinth.

No one doing ear work can claim to be abreast of the times if he does not have an intimate and comprehensive knowledge of the principles underlying these tests. They are to the otologist what the ophthalmoscope is to the oculist, or the stethoscope is to the one skilled in diseases of the chest.

It has been a source of some surprise to me to hear otologists of good repute refer to the functional tests of hearing as being of very limited value for diagnostic purposes. I may be pardoned, therefore, for making the following remarks on this subject:

In order to place it more clearly before us for discussion I will first state the principles on which the tests are based.

First Major Principle.—The range of hearing in adults under 55 years of age is approximately 16 to 48,000 vibrations per second. After the fiftieth or fifty-fifth year the hearing for the upper tones is somewhat reduced, as has been shown by Zwaardemaker, Bezold and others. The very aged do not, as a rule, hear tones higher than 37,000 vibrations per second. This should be borne in mind, as the case might otherwise be mistaken for one with labyrinthine deafness.

Under the first major principle may be grouped two secondary principles which only serve the purpose of elaborating or elucidating it. They are as follows:

(a) Anything which disturbs the normal tension of the drumhead and ossicular chain will diminish or abolish the hearing for the two or three lower octaves.

(b) Any disease affecting the perception apparatus will diminish or abolish the hearing for the upper tones of the range of hearing.

Second Major Principle.—Hearing by bone conduction is approximately one-half as long as hearing by air conduction.

This rule is subject to considerable variation in normal ears, but for practical purposes in the study of these principles we do not need to make a closer analysis. The point to be borne in mind is that hearing by air conduction is longer than by bone conduction.

The second major principle may be still further elaborated or elucidated by two secondary principles, namely:

(c) Hearing by bone conduction is increased in those affections of the middle ear which disturb the normal tension existing between the drumhead and ossicular chain.

* Read at the Fifty-third Annual Meeting of the American Medical Association, in the Section on Laryngology and Otology, and approved for publication by the Executive Committee: Drs. Emil Mayer, C. R. Holmes and G. H. Makuen.

(d) Hearing by bone conduction is diminished or abolished in affections of the labyrinth or perception apparatus.

Third Major Principle.—The intensity of hearing by bone conduction is either increased or diminished by morbid conditions within the middle ear or labyrinth. Two secondary principles may be given in this connection, namely:

(e) Any disturbance of the normal tension existing between the drumhead and ossicular chain will increase the intensity of hearing by bone conduction.

(f) Any disturbance of the perception apparatus will diminish the intensity of hearing by bone conduction.

With these principles in mind we are prepared to discuss their application to the purposes of diagnosis and prognosis.

After having made a careful history of the case, including all subjective and objective phenomena, it has been my custom in both clinical and private practice to test the range of hearing with tuning forks for the lower seven octaves, and with the Galton whistle for the remaining or higher limit of hearing. Note should be made as to whether the lower or higher tones are not heard. According to the secondary principles, *a*, if the lower tones are not heard middle ear or tubal disease is probably present. If the upper tones are not heard it is presumptive evidence of labyrinthine disease, as is shown in secondary principle *b*. Hence, the examination as to the range of hearing is of great value in determining whether the deafness is due to middle ear or to labyrinthine involvement. Thus, if a given case does not hear forks below, say 256 vibrations per second, we would be justified in assuming it to be one of middle ear disease; whereas, if the upper tones of the Galton whistle are not heard it is fair to assume that the labyrinth is involved.

There are exceptions to these conclusions, one being in those cases well advanced in years, when the upper tone limit is normally reduced; another is when there is marked retraction of the drumhead, forcing the footplate well into the oval window. The tension of the intralabyrinthine fluid is thereby increased, and may give the usual functional signs of true labyrinthine disease. The signs will quickly disappear, however, on inflation of the tympanic cavity, and thus clear the diagnosis.

As shown in the second major principle, hearing by bone conduction is approximately one-half as long as it is by air conduction. If, in a given case, bone conduction in the affected ear is relatively longer than hearing by air conduction, the disease is probably within the middle ear. If the Weber test is performed the sound will lateralize to the affected side; or if the Rinne test is made the result will be negative Rinne, i. e., hearing by bone conduction will be longer than by air conduction.

If, on the other hand, bone conduction in the affected side is relatively diminished in duration, it is probably one of labyrinthine involvement. The Weber tests will lateralize to the good or better ear rather than to the more affected side, while the Rinne and Schwabach tests will show a relatively diminished hearing by bone conduction on the affected side. In pronounced cases the hearing by bone conduction is entirely lost in the affected ear.

It is apparent, therefore, that a knowledge of the foregoing principles will render the functional tests of the organ of hearing comparatively easy to comprehend. It is easier to comprehend principles than it is to comprehend tests without a knowledge of the principles on

which they are based. It is, therefore, well to group the tests under the principles which they elucidate. Thus, under the first major principle we may place the test for the range of hearing by the tuning fork and Galton whistle, making note as to whether the lower tones (sub-principle *a*) or the higher tones (sub-principle *b*) are lost.

Under the second major principle we may place the Weber, Schwabach and Rinne tests, as they show the relative duration of hearing by bone and air conduction.

Under the third major principle we may also place the Weber test, as it shows the relative intensity of hearing by bone conduction in the two ears.

And so we may classify all the functional tests of the ear under the various principles which they elucidate. Much confusion arises from a failure to comprehend the principles on which they are based, each test being used as an arbitrary or empiric method of determining the nature and location of the lesion causing the deafness. A better and simpler way to approach this subject is to first study the principles on which the tests are based and then group them according to the principle or principles they are supposed to explain. In this way the various tests and their individual and collective significance will afford a means of greater discrimination in the diagnosis and prognosis of many ear diseases which would otherwise be but partially understood.

There is not time within the limits of this paper to enter into a discussion of the relative merits or significance of the various tests. I wish to say, however, that it is rarely safe to draw conclusions from any single functional test. The composite of several tests, together with the history and clinical phenomena, should all be considered in making the diagnosis.

DISCUSSION.

DR. A. H. ANDREWS, Chicago—I think this is a good time to mention the importance of the entire subject of otology. I think that in most of the medical colleges of the United States it is a sadly neglected subject. I will say, further, that it does not seem to be the fault of otologists, but rather the fault of those who have the arranging of the curriculum of the various colleges that it is not given greater prominence. Medical students need not be specialists, but they ought to know enough to do something with diseased ears. The Doctor states that the relation between air conduction and bone conduction is approximately as 1:2. That is no doubt approximately true, but it makes a great difference on what part of the mastoid the handle of the tuning fork is placed. If it is placed immediately behind the auricle the patient will hear it much longer than if it is placed above or below. If the handle is pressed tightly against the mastoid he will hear it considerably longer than if it is pressed lightly. All these things should be borne in mind in testing bone conduction. Another point is the importance of testing in the first examination both before and after inflation of the tympanic cavity. Sometimes the relation between air conduction and bone conduction will be reversed after inflation. In very many cases it will be materially modified. Not only is this important from the standpoint of functional examinations, but it is very important in making a prognosis. Further, in making tests of bone conduction we will sometimes find that one fork is not heard as well by bone conduction as another fork. I have often seen cases where the C 2, 512 vibrations was not heard as long as a higher fork or a lower fork. I mention the C 2 fork because that is the one most frequently used in testing bone conduction. I have never seen a case of labyrinthine disease in which the intensity of bone conduction was increased. In testing ears with tuning forks we should bear in mind the necessity of having accurate forks and forks that are free from overtones. A fork with overtones will often give very different results from a fork free from overtones. Hold the fork by the handle and strike with a pencil on about the middle of the

prong, and if it gives a ring it has overtones and is not desirable; but if it gives a dead sound, you will then probably get a pure, clear tone and the fork is of value in making these tests.

DR. G. MCAULIFFE, New York City—In dealing with cases of neurasthenia or allied conditions of nerve exhaustion, we should not hold the tuning fork too long in front of the ear. After resting the nerve if we will again approach the ear they will again appreciate the sound. If we do not do this we would get a shortened perception. Another point, in trying the Weber test—which I find the most unreliable one—is to place the fork underneath the mastoid, at the beginning of the sternomastoid. I have been able to get the proper response to the Weber test by this procedure.

DR. S. VOORHEES, Elmira, N. Y.—I would like to ask the Doctor if he does not find, for instance in labyrinthine disease, the higher tones are lost and the lower tones only recognized.

DR. B. A. RANDALL, Philadelphia—I think it is extremely important to get forks that are somewhere near what they purport to be. On testing on the kymographion the various forks furnished you will get some very peculiar results. It is very seldom that they will give the rapidity of vibration set down for them. Second, the value of the fork should be expressed in the frequency of the vibration and not by a symbol, which is so varying in its employment that the term "C fork" may represent at least three different octaves. It is better to employ the complete double vibration instead of the half vibration, as is done by most continental workers. Third, the blow struck should have some semblance to standardization, and in the tuning forks we should have some idea of the bulk of metal vibrating. Not too much of the metal should be in the handle, which should be long in high tuning forks, lest the fork be really heard largely through the air when resting on the head. If we are stating that a fork of, say, 213 1/3 d.v.s., is heard after a standard blow for so many seconds, let us have a standard that it has fallen its own height, that it is of such a length and such a weight. Then when men having different sized forks get different results we will have some clew as to why their results appear different when they are really the same. These things are extremely important; they are really fundamental to any understanding of the matter.

DR. WILLIAM L. BALLENGER, Chicago—In reply to Dr. Voorhees, as a general proposition there will be a loss of hearing for higher tones. The paper I left at home is a discussion of just such subjects as have been brought up in the discussion. It gives the technic of observation and testing and is intended as an answer to such objections. This paper only deals with the general principles.

THE TREATMENT OF TRAUMATIC GANGRENE OF THE EXTREMITIES.*

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In this brief paper it is my aim simply to call attention to a procedure which, in my experience, has proven of great utility in the management of these very troublesome and too often fatal cases. I shall not take up the pathology of traumatic gangrene, for with that you are all familiar, but shall confine myself to its treatment.

On referring to the literature we find all authorities agree that the only treatment of this class of cases consists in early amputation above the gangrenous area.

How often are we able to determine accurately the limits of the disease, particularly in those cases of rapidly spreading moist gangrene? Too often we are disappointed by the continuation of the process after amputation, and are compelled to reamputate much higher, in spite of which the patient often dies.

Again, if the gangrenous process does not involve the entire limb the flaps frequently slough, necessitating another operation and the sacrifice of what is too often

most valuable tissue so far as the future usefulness of the part is concerned.

In other cases I have been convinced by subsequent events that in my effort to get well above the disease I have sacrificed tissue which might have been saved. In other words, I have amputated at a higher point than necessary. The occurrence of any of these conditions neither contributes to the welfare of the patient nor to the peace of mind of the surgeon, and we are all anxious to avoid them as completely as possible.

In casting about for the probable cause of the unsatisfactory course pursued by many of these cases I became convinced that it was the attempt to form flaps from tissue the vitality of which is always seriously in question and the further impairment of that vitality by two procedures necessary to this method of operation. First, the dissection of the flaps; second, the introduction of sutures.

The dissection of the soft parts into suitable flaps necessarily interferes with its blood supply, which interference in the class of cases under consideration is often illy born and frequently resented by sloughing of the flaps or the rapid extension of the gangrenous process up the limb. The introduction of sutures at this time has two distinct disadvantages. The first is the retention within the wound of infectious elements which may have traveled up between the muscle planes or along tendon sheaths to a higher point than we believe probable.

The second is the further interference with the flap nutrition by the suture tension which, no matter how carefully they may be placed, can not entirely be avoided. Believing the statements above made to be true, and that the bearing of these facts on the results secured in these cases was most important, I began about two years ago to treat all cases of traumatic gangrene of the extremities by a method which was entirely original and of which I have been able to find no mention in the medical literature at my disposal.

The procedure is as follows: Being confronted with a case of traumatic gangrene of an extremity, estimate as exactly as possible the line between the diseased and healthy soft parts, and having first under anesthesia made a most careful and complete disinfection and cleansing of the skin, puncturing all bullæ and removing all discharges, envelop the gangrenous area in a sterile towel up to the line selected and at this point make a circular amputation, cutting through soft tissues and bone at the same level. Ligate carefully all bleeding points, including none of the perivascular tissue in the bite of either the forceps or the ligature.

Leave the wound absolutely open, not introducing a single suture, and apply moist dressings of gauze saturated with salt solution. The dressings to be changed two to four times in twenty-four hours, as the circumstances of the particular case demand.

After seven to ten days, if the wound is perfectly clean and the condition of the patient favorable, the classical circular amputation may be made by dissecting up the flap already outlined and sawing the bone at the proper level. If for any reason the circular method may seem undesirable, any other procedure may be substituted, but in the class of cases under discussion a typical circular amputation will be found entirely satisfactory.

I will not burden you with a report of cases, but will simply state that I have employed this procedure four times, once in the upper third of the thigh, once in the middle third of the forearm and twice in the upper third of the leg with uniformly good results.

* Read before the Iowa Association of Railroad Surgeons, Oct. 16, 1902.