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## THE SACCUS ENDOLYMPHATICUS AND AN OPERATION FOR DRAINING THE SAME FOR THE RELIEF OF VERTIGO\*

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The contribution to the therapeutics of vertigo which forms the subject of this work establishes the practical result of a series of researches on comparative anatomy, human anatomy and physiology of the saccus endolymphaticus, which I have pursued incessantly for the last eight years.

The study of anatomy has shown me the occurrence and the considerable dimensions of the saccus endolymphaticus in the vertebrates and specially in man.

True intracranial extension of the labyrinth is seen in a depression which I have called the 'fossa endolymphatica', lying on the postero-medial surface of the petrous temporal. The sac lies in a space in the thickness of the dura mater, which is divided into two layers, an antero-inferior placed against the petrous bone, and a postero-superior or cerebellar in relation to the arachnoid and cerebellum. The lateral sinus skirts half its outer circumference and is only in this situation separated from it by some connective tissue layers.

The saccus, in direct relation through the ductus endolymphaticus with the membranous cavities, utricle and saccule, is found to contain a clear fluid which is the endolymphatic fluid.

In October 1922, I presented before the International Congress of Otology some of my experiments on fish, in which I endeavoured to prove the importance of the endolymphatic organ in aural physiology. Since then I have carried out fresh researches in order to confirm the former results, and I believe that at the present moment the functional importance of the saccus endolymphaticus is no longer contested by anyone.

In man, in whom anatomical conditions are essentially different, and in whom alone physiology and pathological anatomy can enlighten us, we are right in thinking that the saccus owing to its situation in the substance of the dura mater is in constant relation with the pressure in the subarachnoid space.

Modification of the tension of the cerebrospinal fluid is then liable to disturb the normal function of the labyrinth. This is a question that is beginning to occupy the minds of some investigators, and in January 1925, George Ferreri published in the *Revista Oto-neuro-oftalmologica* the result of his work on the action of

experimental hyperpressure of the spinal fluid on the posterior labyrinth. Quite recently, namely in June 1926, and following upon the results I had obtained with regard to fish, W. J. McNally has, in the Pharmacological Laboratory of the University of Utrecht,† undertaken a series of experiments on the rabbit, in which he provoked both an increase and diminution of pressure at the situation of the saccus endolymphaticus.

Although he has not noticed any labyrinthine disturbances in producing hyperpressure on the saccus (on this subject fresh experiments appear necessary) the opening of the saccus owing to the escape of the endolymphatic fluid has produced invariably a lessening of the *tonus* of the limbs on the same side.

A phenomenon, supervening on the lessening of tonus of the homolateral limb, as Magnus and de Kleijn have proved, is produced after opening of the membranous labyrinth or, according to the experiments of Arndts, is produced after section of the eighth cranial nerve.

These facts having been admitted, allow us to comprehend the importance of modifications of pressure either of intracranial origin, that is to say, exlabyrinthine, or of endolabyrinthine origin; they are, further, of importance in connection with the saccus endolymphaticus.

Now, the saccus may be compressed by pathological conditions affecting an adjacent organ, such as the lateral sinus, or the meninges and cerebellum. The increase of pressure produced through the saccus endolymphaticus upon the intrapetrous labyrinth may give rise to the Ménière syndrome; vertigo, deafness, tinnitus. It appears therefore to be logical to incriminate the saccus endolymphaticus or the vestibular nucleus when the symptoms arise during an intracranial hyperpressure, whatever may be the cause of such symptoms.

Again, the increase of endolymphatic pressure may proceed from an endolabyrinthine cause, and a long time ago attention was drawn by otologists to serous labyrinthitis; the increase of the endolymphatic fluid sets up in the cochlear, otolithic and vestibular nerves, functional trouble which evokes the appearance of the triad of Ménière, thus bringing about a true 'aural glaucoma'.

There exists elsewhere more than one analogy

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†W. J. McNally, 'Experiments on the Saccus Endolymphaticus in the Rabbit,' *Journ. of Laryng. and Otol.*, vol. xli., June 1926.

between intraocular hypertension and endolabyrinthine hypertension of serous origin. In one case, as in the other, the question is more often that of crisis of localized hyperpressure occurring in subjects of high blood pressure or subjects with a hyper-excitable sympathetic system.

The recent and very interesting researches performed by Guild, in the Department of Anatomy, University of Michigan, and presented in May 1927, before the American Otological Society in New York, show us the importance of the saccus endolymphaticus as an organ of filtration of the endolymphatic fluid. It serves as the principal place of outflow of the endolymph; not, as some have thought, as the point of origin of endolymph. The escape of fluid is not through openings in the wall,

but by direct passage through the layers of the wall, being thus comparable to the flow of cerebrospinal fluid through the arachnoid villi. Thus in some cases the possible interpretation of abnormal distension of the membranous labyrinth (aural glaucoma) as an impairment of the normal pathway of the endolymph can be discussed.

To continue our comparison, as in glaucoma the ophthalmologists puncture the cornea in order to suppress the intraocular hypertension, capable of destroying for ever the value of the eye; so it seems logical in some cases of serous labyrinthitis, when medical treatment has failed, to make a decompression of the internal ear by the removal of the excess of endolymphatic fluid.

The membranous labyrinth protected in the centre of this thick, strong box, the bony capsule of the laby-

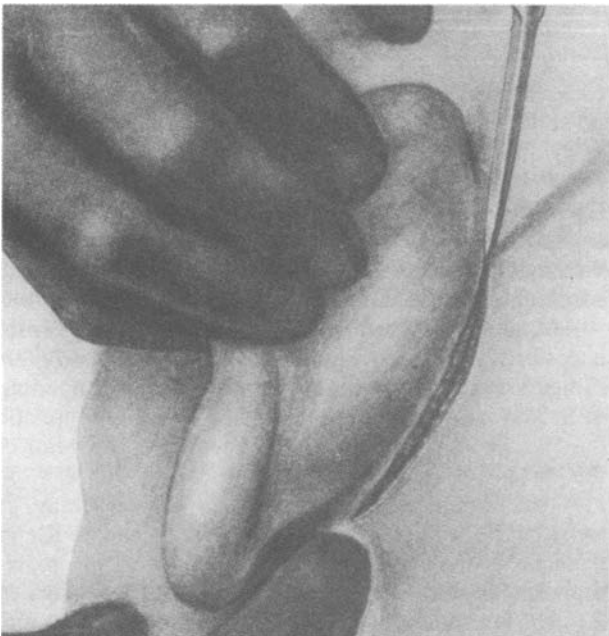


FIG. 1

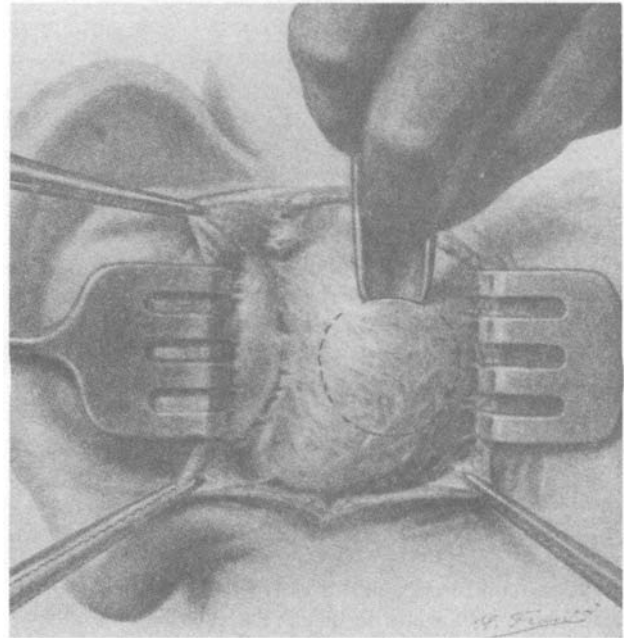


FIG. 2

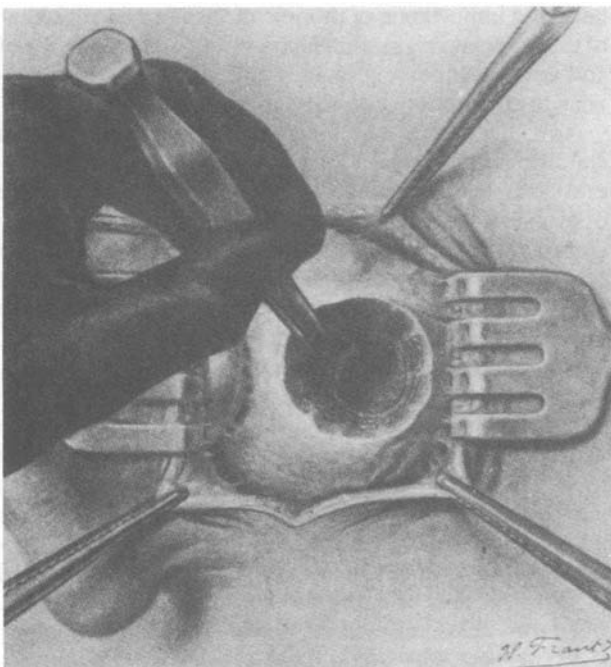


FIG. 3

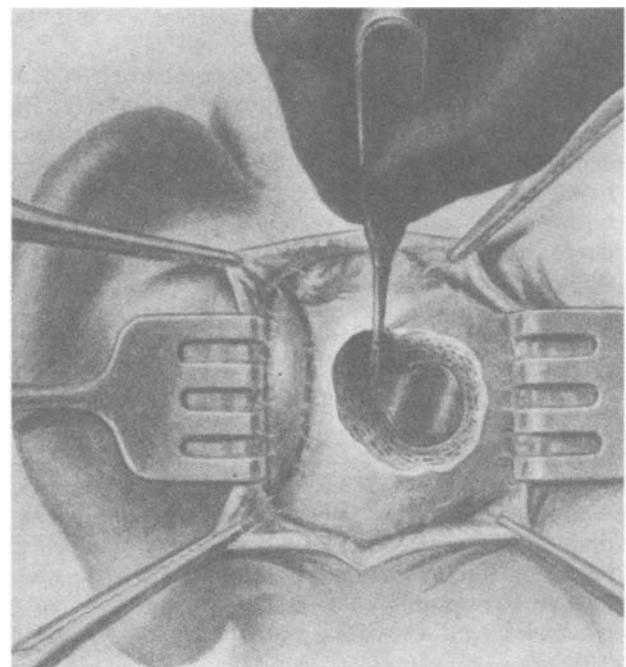


FIG. 4

rinth—separated too from the bony capsule by the perilymphatic spaces—is practically inaccessible and safe from destruction. At one point only it is vulnerable, namely, at the site of the endolymphatic sac, placed in the fossa which bears its name, on the posterior surface of the petrous bone. It is there that it is well to carry out a decompression operation on the labyrinth.

In this way the otologist obtains a new perspective of surgical therapeutics in those cases in which one might suspect the existence of a serous labyrinthitis, or where a cranial hyperpressure, whatever the cause, will produce a violent reaction of the labyrinth.

My operation consists in reaching the fossa endolymphatica and in discovering the saccus in order to open its petrous wall. Exact knowledge of the relations of the fossa endolymphatica is then indispensable. Let us recollect that, situated on the plane of the posterior surface of the petrous bone, this triangular fossa, at the supero-internal angle of which opens the aqueductus vestibuli, is in relationship externally with the lateral sinus which passes round its outer and lower part before reaching the jugular bulb at the level of the external part of the foramen lacerum posterius.

The easiest route of access, therefore, is to the external part of the fossa endolymphatica, the lateral sinus being in fact the most invariable landmark. On the other side, the fossa extends to 5 mm in front of the vertical portion of the aqueductus Fallopii. By starting from the internal border of the lateral sinus, but remaining on the plane of the zone between the sinus and the facial canal, one reaches the fossa.

In a word, it is necessary to search for the saccus through the mastoid in the area of a triangle formed above, by a line corresponding to the floor of the antrum, in front by the aqueductus Fallopii, behind by the lateral sinus.

### Operative technique

*First step*—The incision is made down to the bone

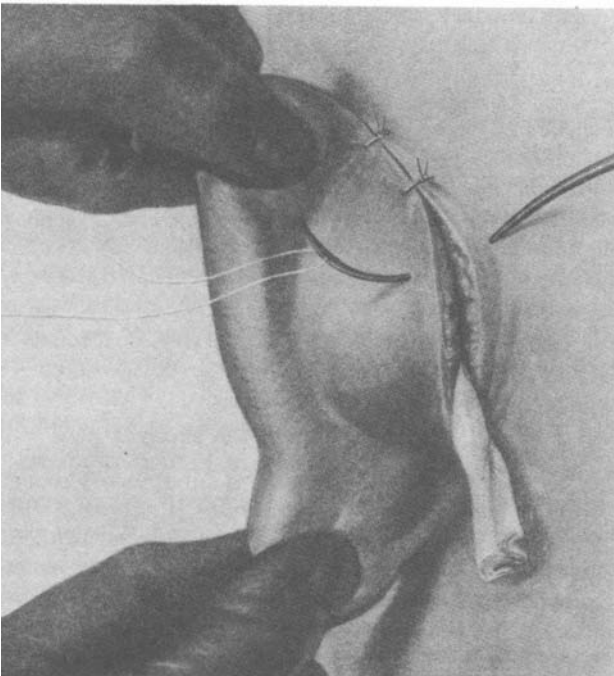


FIG. 5

along the retro-auricular groove and the surface of the mastoid is exposed. The spine of Henlé and the external petrosquamous suture are disclosed (Figs. 1 and 2).

*Second step*—Trepanning of the mastoid is carried out on a plane situated lower than that of the classic trepanning area for mastoiditis. The first stroke of the gouge is made on a horizontal line passing under the spine of Henlé. The second anteriorly on a vertical line situated 3 mm behind the posterior edge of the external auditory meatus; the third is made horizontally at 1 cm below the first (Fig. 2). These three strokes of the gouge are made perpendicularly to the surface of the bone; at the fourth application, on the contrary, the instrument is held obliquely on the bony surface, 1 cm behind the second. In gouging this deeply, one finds the lateral sinus, the true landmark of the operation.

This 'square of attack' has as its aim the approach to the lateral sinus without opening the antrum, thus keeping the operation as aseptic as possible, without extensive communication with the middle ear.

*Third step*—The bony wall of the sinus groove having been exposed and its medial part removed, one detaches with a blunt elevator, as delicately as possible, the dura mater which covers the posterior surface of the petrous bone, passing in a direction medially and slightly upwards for a distance of about 3 to 4 mm. (Fig. 3). A protector is then put in position, for it is now necessary to divide with a fine graving tool the bony area which represents the most external part of the fossa endolymphatica. At this point the aqueductus Fallopii is near, and the facial nerve could be injured by an unlucky stroke of the operator.

This bony region having been ablated, one again exposes the dura mater, always in a direction medially and slightly upwards, until one comes to a zone of closer adhesion of the dura mater to the bone to a slight bony depression. We have now arrived at the level of the supero-internal part of the fossa, at the exact point where the aqueductus vestibuli begins.

*Fourth step*—The petrous wall of the saccus endolymphaticus is freed by removing the greater part of the fossa endolymphatica. By the help of a very fine needle, mounted on a Luer syringe, one makes an exploratory puncture of the saccus in contact with the zone of adhesion (Fig. 4). The operator, who feels perfectly the sensation of penetrating the little cavity of the saccus, then makes, with a paracentesis knife, an incision from 2 to 3 mm long into the saccus. One or two drops of fluid, like spring water, flow from the opening of the wound.

The operation now being over, the retro-auricular wound is sutured. Slight drainage is rendered possible by the insertion of a piece of gauze, in the event of any considerable bleeding in the course of the bony trepanning (Fig. 5).

A particular point of detail in technique must be noted; the puncture, just as much as the incision, of the saccus, ought to be made as medial as possible, near the zone of the adhesion.

The saccus, which is occasionally atrophied in old age, may be reduced in size only where it is in apposition to the posterior canal. In making the incision far from the zone of adhesion, the leptomeninges may be reached and the saccus missed. By operating at the contact of the bony wall which constitutes the supero-internal part of

the fossa, one is sure to reach the saccus even if it were much atrophied.

This operation, though difficult to perform, is generally comparatively simple, as I have shown in my Clinic at the University of Bordeaux. To me it seems to be the selected method of reaching the saccus endolymphaticus and appears to be full of promise for the surgical therapeutics of a great number of labyrinthine diseases, one symptom of which at least, namely, the vertigo, is particularly painful to the patient.

I have on several occasions practised this operative intervention on the living most successfully, and quite recently (10 October 1926) I operated (1) at Groningen, before the International Oto-Rhino-Laryngological College, and (2) at Rome (23 October 1926) before the Italian Congress of Oto-Neuro-Oculists, on two typical cases of vertigo, cured by opening of the saccus endolymphaticus. The severity of the vertigo prevented the unhappy patients who were attacked by it from doing any kind of work.

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