THE
JOURNAL OF LARYNGOLOGY,
RHINOLOGY, AND OTOTOLOGY.

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**SOME PRACTICAL CONSIDERATIONS IN THE DIAGNOSIS
AND TREATMENT OF ABSCESS OF THE CEREBELLUM
WITH A RECORD OF CASES SUBJECTED TO OPERATION.¹**

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THE relative frequency of temporal lobe abscess as compared with cerebellar abscess is still a matter of controversy.

Heimann gives the proportion as 68·3 per cent. of the former to 31·7 per cent. of the latter; Neumann 63·4 per cent. to 46·6 per cent. Such a small difference is, therefore, comparatively speaking, of no importance and substantiates what has generally been taught, viz., that cerebral abscesses occur twice as frequently as cerebellar. Curiously my own experience has been precisely the reverse, having, in the course of practice, seen almost three times as many cerebellar as cerebral abscesses. The decades of life from 10–20 and from 20–30 undoubtedly provide the largest number of cases, while males are affected twice as frequently as females, and in my own experience abscess upon the left side is twice as frequent as abscess upon the right side.

The actual route of infection provides an interesting pathological study. In acute cases the sequence of events is, as a rule, the formation of an extra-dural abscess in the posterior fossa or

¹ Paper read before the Section of Surgery at the meeting of the British Medical Association, Aberdeen, July, 1914.

a thrombosis of the lateral sinus with secondary infection of brain tissue, whereas the great majority of chronic cases are secondary to labyrinthine suppuration, the aqueductus vestibuli affording the actual path of communication in nearly 30 per cent., the other usual routes of infection being the result of sinus thrombosis and extra-dural abscess in relative order of frequency.

The fact that the labyrinth has of recent years been proved to play such an important rôle in the production of posterior fossa suppuration has naturally tended to focus attention upon those signs and symptoms which might be of clinical assistance in the differential diagnosis of cerebral, cerebellar, and labyrinthine suppuration.

Of the many important clinical indications no one is of more importance than nystagmus, the proper interpretation of which may be the means of securing an accurate differential diagnosis and consequently a correct method of surgical approach to the existing focus of suppuration.

Of the two components the primary or slow is the true vestibular reflex, although in actual practice the direction of the secondary or quick movement is the one which is held to determine the particular type of nystagmus present. When the quick deviation is to the right the nystagmus is spoken of as a right nystagmus, when to the left as a left nystagmus.

Nystagmus may be spontaneous or induced, vertical, horizontal, or rotatory.

In uncomplicated disease of the labyrinth it is at first directed towards the affected side, but soon changes over and is directed to the opposite or sound side. It remains directed towards the *sound* side throughout the course of the disease, and as the function of the labyrinth is gradually destroyed it becomes less and less obvious until finally it disappears.

On the other hand, a spontaneous nystagmus, the result of suppuration within the cerebellum, is directed first towards the sound side and very shortly afterwards towards the affected side. It remains throughout the course of the disease directed towards the *affected* side and increases, *pari passu*, with the progress of the suppurating focus within the cerebellum. It is true that it may also incline towards the sound side, but the greater and more obvious deviation is invariably towards the affected side.

Important as the differential diagnosis of labyrinthine and cerebellar suppuration is, the recognition of the fact that cerebellar suppuration complicates labyrinthine suppuration in a given case is

of almost more importance from the clinical standpoint. Under such circumstances an estimate of the irritability of the labyrinth is of the greatest value. Thus if a rotatory nystagmus be present towards the *affected* side and the labyrinth be found non-irritable an immediate diagnosis of cerebellar abscess may be made, more especially if symptoms of intra-cranial pressure be present at the same time.

If, however, a rotatory nystagmus be present toward the *sound* side and the labyrinth be non-irritable the lesion may be either labyrinthine or cerebellar, and it is not possible to arrive at a definite diagnosis without first performing a labyrinthectomy.

If the nystagmus were of labyrinthine origin it would, after operation, disappear within a few days, if of cerebellar origin not only would it persist, but it would become more marked, while not infrequently its direction would be reversed and towards the affected side.

In estimating the degree of labyrinthine irritability, the caloric test, irrigation of the ear with hot or cold water, is the most convenient, the most easily applied, the least distressing to the patient, and moreover has the great advantage that it can be applied to one side at a time, and with the patient in bed or in a sitting posture.

For the cold water test, water at a temperature of 27° C. or 80° F. should be employed; for the hot water test, water at a temperature of 110° F. The time required for the induction of nystagmus depends upon certain extra-labyrinthine factors, whereas the duration of the nystagmus depends upon intra-labyrinthine or central conditions. To fix the position of the semicircular canals an oto-goniometer is employed. The upper rod of the goniometer, to which is attached a graduated arc, moves in a vertical plane, whereas the lower moves in a horizontal plane. To the distal end of the horizontal rod, which moves across the upper surface of a graduated arc, is attached a small mirror.

The object of a vertical rod is to determine the position of the external semicircular canal. If the head be held in the upright position and the vertical rod be raised through an angle of 30° its plane will correspond with the plane of the external, mis-named horizontal, semicircular canal, and if it, the head, be now bent backwards until the rod is vertical the plane of the external canal will be vertical also.

The lower rod with its attached mirror is used to fix the position of the eyes, being rotated through an angle of 50° to one or other side of the median line, according to whichever ear is being

tested, and until the patient is able to see distinctly some object in the room reflected in the mirror.

To perform the caloric test the water from the calorimeter is allowed to flow into the auditory meatus, the rate of flow being so regulated that 300 c.c. flow through in three minutes. In a normal ear with an intact *membrana tympani* nystagmus would be induced in from thirty to forty seconds, or after about 70 c.c. of water had passed through the apparatus.

When cold water impinges upon the outer labyrinthine wall it cools the endolymph in the most superficial parts of the canals, that is the anterior portion of the external canal, and the ampulla of the superior canal, with the result that a movement is induced in the fluid owing to the difference of specific gravity between the cold and warm portions of the endolymph. If the cold water is run into the right ear the endolymph in the ampulla of the right superior canal becomes rapidly chilled. The diminution in temperature makes it heavier with the result that it falls towards the utricle. This creates a convection current towards the utricle, and as each portion of the fluid flowing from the superior canal comes under the influence of the cold water flowing through the meatus it likewise becomes cooled, with the result that the whole of the endolymph becomes ultimately of the same temperature. In this way a rotatory nystagmus to the opposite side is produced.

The horizontal canal is normally tilted backwards about 30°. As the cold water reaches its anterior portion the endolymph is cooled and flows downwards, that is away from the utricle, with the result that a horizontal nystagmus is produced also to the opposite side.

To secure the most marked and rapid effects with the caloric test the head should be placed in the *oblique optimum position*, that is bent backwards through an angle of 60° and tilted towards the corresponding shoulder through an angle of 45°. In this position an almost pure horizontal nystagmus to the opposite side is produced.

The caloric test, moreover, permits of a separate examination of the external and the vertical canals. Thus if the head is placed in the *oblique optimum position*, that is, bent backwards through an angle of 60° and tilted to the same side through an angle of 45°, and the caloric test be applied without inducing nystagmus then the external canal is not functioning. If now the head is thrown forwards into the *pessimum position*, i. e. 30° forwards from the vertical upright position, and the test re-applied and a rotary

nystagmus be induced the vertical canals are intact. In this way it is possible to diagnose a circumscribed labyrinthitis confined to the external canal.

In a case of suspected right labyrinthitis with spontaneous nystagmus to the left we irrigate the ear with hot water. If the labyrinth is still functioning a nystagmus to the right is set up which neutralises or may even overcome the nystagmus to the left, but if, on the other hand, the nystagmus is unaffected, the labyrinth is not functioning normally.

The more irritable the labyrinth the more rapid the incidence of nystagmus, and *vice versâ*, due allowance being made for such pathological conditions as may influence temperature conductivity.

In labyrinthine disease the tendency to fall is always in the direction of the slow component of the nystagmus, in other words, in a direction opposite to the observed nystagmus or towards the affected side, whereas in cerebellar lesions the tendency to fall is independent of the direction of the nystagmus.

It is now held that there are central centres of co-ordination in each cerebellar hemisphere which regulate the ipso-lateral movements of the limb, while similar centres in the vermis regulate the head, neck, and trunk movements.

Injury, whether experimental or from disease, to definite areas of the cerebellar cortex produces disturbances of a functional nature in muscle groups of the same side, while if the injury be very severe the centres governing the whole limb may be implicated. It would appear as if there existed a centre in the cerebellar cortex for each movement of a limb, and for each articulation, for flexion and extension, for adduction and abduction, etc.

Localised lesions of the cerebellum induce an *anisosthenia* or disturbance of that equilibrium which normally exists between antagonistic groups of muscles. Hence the clinical significance of Bárány's pointing-by test.

In lesions of the labyrinth the pointing-by test is in the direction of the slow component of the nystagmus, that is, in a direction opposite to the observed nystagmus. In cerebellar lesions this reaction is lost. For example, in the case of a left-side suppurative middle-ear lesion, where it is difficult to determine whether a labyrinthitis and a cerebellar abscess co-exist, the spontaneous nystagmus is to the right or sound side and the pointing-by test to the left. In such a case the lesion may be either labyrinthine or cerebellar. If now the right ear be irrigated with cold water, a nystagmus to the left is produced. If it be a labyrinthitis the

pointing-by test will be to the right, whereas if it be a cerebellar lesion the reaction is lost and the pointing-by test of the left leg or arm is to the left, in other words, to the side of the cerebellar lesion.

In certain cases also the presence of *dysdiadokokinesis* or an impairment of the movements of pronation and supination is an important indication. In four of my cases it was quite marked, the movements being made (as compared with those of the opposite side) slowly and clumsily and with the aid of the shoulder-joint muscles.

The fact that intra-cranial suppuration develops as a rule in the immediate proximity of the septic focus to which it owes its origin, and the fact also that labyrinthine suppuration is the proximate cause of cerebellar suppuration in from 40 to 50 per cent. of cases, naturally suggest that any intra-cranial abscess which may be present will be found in the lateral lobe of the cerebellum and well forwards. Hence the ideal surgical approach to such an abscess is through the posterior wall of the petrous portion of the temporal bone in the space between the lateral sinus and the internal auditory meatus. Exploration along this route is much more likely to be the means of discovering an existing abscess than exploration behind the groove of the lateral sinus.

Prior to any exploration, however, I am in favour of withdrawing a few drachms of cerebro-spinal fluid by lumbar puncture in order to obviate the incidence of sudden arrest of respiration or cardiac failure, a by no means unknown phenomenon in lesions of the cerebellum. Objection has been made that the withdrawal of cerebro-spinal fluid prior to operation and the consequent decrease of intra-cranial pressure thereby resulting may cause a cerebellar abscess, superficially situated, to burst into the meninges. While admitting the possibility the chances of its happening are very remote if only a few drachms of fluid are removed, whereas the possibility of sudden death during operation from undue intra-cranial pressure is now not only recognised by all operators, but has frequently actually taken place on the operating table. In an analysis of 196 cases of cerebellar abscess made by Neumann in 10 instances death took place from sudden respiratory failure.

In three of my own cases operation was successfully completed while artificial respiration was kept up owing to sudden paralysis of the respiratory centres.

On the other hand if too much fluid be withdrawn the brain stem may fall downwards into the foramen magnum or may even become twisted.

In my earlier operations I was in the habit of opening the cerebellum behind the lateral sinus and, unfortunately, frequently missed the abscess, which was subsequently found situated far forwards and inwards in the immediate neighbourhood of the internal auditory meatus.

During the last few years I have invariably explored through the posterior antral wall, and have rarely missed finding the collection of pus, which, as a rule, is fairly superficial and at the same time of comparatively small size—small at any rate as compared with temporal lobe abscesses.

Drainage tube for abscess of the brain.

One of the most difficult problems in the treatment of intra-cranial suppuration is the question of the maintenance of free drainage. In acute abscesses the tendency is for the walls of the so-called cavity to fall together, hence the problem of drainage presents no great difficulty, a few strips of gauze inserted into the cavity being sufficient to ensure the continuous escape of secretion. In chronic abscesses where one has to deal with a pyogenic membrane of a varying degree of thickness and resistance, and where healing is the result of progressive agglutination of granulation tissue, the matter is entirely different, as it is necessary to maintain uninterrupted drainage until this process is complete. Every surgeon who has had to deal with such cases knows full well how the tube employed is prone to become blocked with fragments

of brain tissue or inspissated pus, and how, as the result of retention of secretion, pressure symptoms reassert themselves. I would, therefore, like to put in a plea for the more frequent employment of counter-drainage, which I have found of great service. The objection offered to counter-drainage, viz. that another wound is made in the dura and in the brain substance itself, is to my mind quite counter-balanced by the fact that a free path for efficient irrigation is provided, and that the removal of the tube for cleansing purposes is done away with, to say nothing of the practical difficulties frequently experienced in returning the tube to its proper habitat.

If the primary opening be made, as already suggested, through the posterior antral wall, the secondary opening should be behind the groove of the lateral sinus and a tube should be inserted through both openings.

If a rubber tube be employed it is advisable to wrap it round with a thin layer of gauze so as to permit of the continuous escape of fluid secretion. My practice is to insert a small rubber tube through the opening made in the posterior antral wall and a silver tube of special construction through the opening made behind the lateral sinus. The silver tube (Figs. 1 and 2) consists of a tube within a tube so arranged that while a space normally exists between the two tubes for the exit of fluid secretion, the inner tube may, should necessity arise, be unscrewed and removed without in any way interfering with the position of the outer tube.

The results following operative interference for the relief of abscess of the cerebellum still leave much to be desired. When it is remembered, however, what a large percentage of the cerebellar abscesses met with in actual practice are complicated by the presence of sinus thrombosis or posterior fossa meningitis the wonder is that statistics are not worse than they actually are.

I venture, Mr. President, not, however, without a feeling of trepidation, to place the results obtained during the past ten years of practice before you.

Number of cases operated upon, 27. Males, 17; females, 10. Side: right, 7; left, 20. Cured, 17. Died, 10.