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THE LEAKING BRAIN ABSCESS

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CASE I.*—On February 5th, 1925, a lady, aged 59 years, consulted me for a discharge from the right ear. Two years earlier a radical mastoid operation had been performed on it by Dr. R. H. Craig of Montreal, at which, as he later on kindly informed me, nothing of note occurred save an exposure of the dura of the posterior cranial fossa. Since the operation there had been some purulent discharge from the ear, and six months before I saw her she had had several attacks of severe vertigo. A month before her visit to me she had also consulted Professor Ruttin while passing through Vienna.

I found the right ear full of pus and the fluid mass was pulsating. The mastoid scar was sound and not inflamed. Hearing was but slightly reduced, the bone conduction through the mastoid being +8 inches.

On February 16th, the mastoid was re-opened, Dr. O'Reilly of Halifax, Nova Scotia, assisting. A small mastoid cavity was found full of livid granulations. But what staggered us was the discovery of a large fistulous opening through the bone of the antro-tympanic roof and through the dura of the middle fossa into a large cavity in the temporo-sphenoidal lobe of the brain. There was no pus in it but it was occupied by the same kind of livid granulations as had been seen in the mastoid. An empty temporo-sphenoidal abscess was diagnosed, and, as it seemed to have been draining sufficiently, we left it alone.

Subsequent enquiry, addressed to her former surgeons as well as to the patient herself, failed to disclose when the brain abscess had formed and discharged, the only suggestive item in her history being

* The cases numbered are those that have been under my own observation.

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the attacks of vertigo already mentioned as occurring six months previously.

Progress after our exploration was uninterrupted until a fortnight later, when, the patient having left the nursing home, she was suddenly seized in the street with epileptiform convulsions. Examination during the fits, which lasted five hours, revealed no localising signs. Eventually consciousness was regained and no more fits occurred. A few days later Sir Charles Ballance saw her in consultation, and, all blood examination being negative, advised exposing the dura more widely and incising it for decompression. This was done and recovery followed. Four years later I saw her again. There was no purulent discharge from the ear, but a constant though scanty flow of clear watery fluid had been noticed by the patient. (? Cerebrospinal fluid.) The external auditory meatus was closed by an epithelialised mass, probably a cerebral hernia. Her general health was excellent.

Apparently what we had to deal with here was an open abscess cavity in the temporal lobe communicating with and draining freely into the old tympano-mastoid cavity. The latent formation, rupture, discharge, and progress towards cure of a brain abscess, seemed to us at the time a remarkable, if not a unique succession of clinical happenings. But subsequent experience and reading have modified this view so considerably that the question has arisen in my mind whether such a course of events is not really rather common, at least in so far as the formation and discharge of the abscess are concerned. In any case, as spontaneous rupture and discharge, whether internally or externally, may modify the course, prolong the duration, and influence the treatment of the disease, the subject is worthy of a little more direct attention than has hitherto been bestowed upon it.

We are all only too familiar with the brain abscess which, bursting into ventricles or meningeal spaces floods the cerebrospinal system with virulent pus and leads to death in a few hours. But this type of case I am leaving aside. What the present paper will be dealing with is the spontaneous rupture and gradual discharge of a brain abscess, whether internally or externally, in such a manner as to merit the name given to it in our title, namely, *leaking* brain abscess.

We shall deal first of all with *internal leakage*, that is to say, leakage into the meningeal spaces. The surprising fact about it is, that it may be recovered from.

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I can mention three of such cases, one reported by E. Broughton Barnes, and two of my own. Two of them recovered and one died. An account of the fatal case was published in 1926, and the following is a résumé of the report.

CASE II.—*Recurrent Meningitis from a Leaking Cerebellar Abscess.* A boy of 7 years was admitted to the Central London Throat and Ear Hospital in October, 1922. He was semi-comatose, the illness having been ushered in by severe occipital headache of three days' duration. There was chronic suppuration of the left middle ear, but, apart from cervical rigidity, no other localising sign was detected. The temperature was normal. The cerebrospinal fluid from the lumbar spine was turbid and contained a coliform bacillus. Immediate operation revealed a cerebellar abscess and it was drained. Consciousness was restored in a day or two and all the meningeal symptoms quickly disappeared. At the end of the week the drainage tube was expressed from the brain. A week after that, however, the mental hebetude and cervical rigidity reappeared and the temperature rose to 103° F. So the abscess was re-opened and the tube replaced. Again all symptoms disappeared. Again the tube was expressed. Again the meningitis recurred. And again the abscess was opened. This sequence of events occurred no fewer than five times in all, until finally, after a struggle lasting for three months, the boy died. The necropsy provided the solution of our clinical conundrum. There were two cerebellar abscesses, separate and distinct from one another. The more accessible collection we had been draining. The other had never been reached. In the former, a tiny nipple-like opening led into the cisterna pontis. What had been happening was that the satellite abscess re-infected the primary abscess each time the latter ceased to drain, and each time that the primary abscess filled up it leaked into the cisterna through the nipple-like opening and set up meningitis. Until the final attack, the meningitis was recovered from as soon as the abscess was drained and the leakage thereby stopped. At the *post mortem* the meningeal spaces at the base were seen to be crowded with thick connective tissue bands.

Had it not been for the unsuspected secondary abscess the patient would undoubtedly have recovered, as did the case reported by E. Broughton Barnes in which meningitic attacks came and went at intervals of a few days. The cerebrospinal fluid contained organisms. Drainage of the abscess led to cure.

The third case was one in which internal and external leakage seemed to be combined.

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The patient (CASE III) was a girl of 15, conscious and, when I first saw her, screaming with headache. The classical signs of meningitis were present. The mastoid of the discharging ear was forthwith opened and its cells were found to be full of pus but devoid of granulations. That is to say, the cells were healthy but had been recently filled with pus from some hidden focus. Search disclosed a fistula of the bone and dura of the posterior fossa leading to a cerebellar abscess. Drainage was instituted and, much to my surprise, the patient made a rapid and complete recovery.

It will be noted that all three of those cases of internal leakage were cerebellar. The absence of temporo-sphenoidal abscess from this group is probably due to the fact that this abscess tends to become larger than the cerebellar abscess, and so, when it ruptures, the quantity of septic material poured out is too great to be dealt with successfully by local defences, and the patient dies.

It will doubtless be remembered, however, that G. J. Jenkins has recorded a case in which, after rupture of a temporo-sphenoidal abscess into a ventricle, he succeeded in saving the patient by irrigating the meningeal spaces. His case I am not including in this series as it belongs to the variety in which a catastrophic rupture rather than a continuing or recurrent leakage takes place.

So much for internal leakage, instances of which are uncommon in the literature. The reverse, however, would seem to be true of external leakage, since no fewer than ten indisputable cases are referred to since 1924 in this *Journal* alone. To these I can add three of my own.

It is interesting to find, by the way, that of the total number of brain abscess cases reported in his book by Macewen, twenty-one in all, no fewer than six were leaking, a proportion that will probably surprise the reader as much as it surprised the writer of these lines. Inasmuch, however, as Macewen's cases were, most of them, of longer standing than those reported in our own days, they will not be included in the present analysis.

In our other British classic, Sir Charles Ballance's " Surgery of the Temporal Bone " we find four leaking cases out of fourteen of temporo-sphenoidal abscess, but only one doubtful instance in eleven cerebellar cases. (It will be remembered that these are cases selected from divers sources for illustrative purposes.)

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Before proceeding with my own comments, I may say that in recent literature the fact of leakage receives only a casual mention in the narratives of the cases reported. The influence of that particular incident upon the course of the disease is not dwelt upon.

I commence with an illustrative case of my own.

CASE IV.—A woman aged 45 developed unilateral acute otitis media with severe pain and headache in and above the affected ear. After five days of observation, during which discharge and pain persisted but with a normal temperature, the Schwartze operation was performed upon what turned out to be a cellular mastoid containing pus and granulations. For three days following the operation the pain was absent, but it returned and persisted until the ninth day when it suddenly disappeared, its disappearance coinciding with the onset of a copious outflow of thick yellow pus from the mastoid wound. The presence of a large extradural or brain abscess was at once suspected, but, as the drainage seemed to be quite free, pain and headache were absent, and none of the symptoms and signs of an intracranial complication could be detected, we temporised. As time passed, however, it became evident that the patient was not making headway. She was becoming dull and listless and was losing colour and weight. The mastoid was therefore re-opened and, after a long search, a fistula was found in the roof of the tympanum, too far forward to have been encountered in the Schwartze operation. After completion of the radical operation, the fistulous opening, which led to a large temporo-sphenoidal abscess, was enlarged, and a tube inserted. But meningitis supervened and the patient died five days later.

The noteworthy features of the case are, first of all, the sudden relief to the pain that accompanied the appearance of copious discharge; second, the absence of all signs of an intracranial complication (until the meningitis appeared); and third, the post-operative meningitis.

We turn now to examine our thirteen collected cases. First of all, as to situation. In ten, the abscess occupied the temporo-sphenoidal lobe; in one, the cerebellum; in two, the frontal lobe (from frontal sinusitis; both recovered).

In five, the fistula was accidentally discovered during the performance of a mastoid operation, the cases therefore being instances of what Macewen calls "otorrhœa cerebralis". (T. H. Just; G. W. Dawson; W. S. Syme; J. C. Watt.) In three, the leakage was first observed during convalescence from

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a cortical mastoid operation. (H. B. Thorne and two of my cases.) In six of the ten temporo-sphenoidal and in both of the frontal abscesses the leakage came through the " stalk " of the abscess. That is to say, in most the pus returned by the route along which the infection had passed into the brain, a point we shall again allude to later on.

But other and surprising channels of escape may be found or formed by the pus. In three (Horsley Drummond; R. Ritchie Rodger), an abscess in the soft parts of the temporal fossa was found when opened to communicate, through a fistula in the squama or greater wing of the sphenoid, with a collection in the brain, and a most remarkable case is reported by Gordon Berry. An abscess in the left middle cranial fossa near to the optic chiasma was diagnosed from the general symptoms. The patient, an adult male, was noticed by a nurse to be coughing up thick foul pus at intervals, for which reason the left posterior ethmoidal and sphenoidal cells were opened, but no disease therein was discovered. Eventually, the brain was explored for abscess with a negative result. Death from meningitis ensued, and the necropsy showed a large temporo-sphenoidal abscess reaching into the pituitary fossa, in the floor of which was found a necrotic opening leading directly into the left sphenoidal sinus. The abscess was attributed to nasal sinus suppuration, and it had ruptured into the lateral ventricle.

It is to be noted that the presence of the outlet had not been sufficient to obviate pressure symptoms or to prevent the rupture of the abscess into the ventricle.

Macewen, by the way, tells of a frontal lobe abscess which broke through the cribriform plate and ended in recovery. In several of his cases, we may remark, leakage of a cerebellar abscess was observed by way of a thrombotic lateral sinus, an involved and tortuous route. He also describes one in which pus from a cerebellar abscess found its way to the deep cervical regions through the posterior condylar foramen. But cerebellar abscess leakage, as we have seen, is rare, probably because of its relatively remote situation from the mastoid region and the cranial bony wall. The path to the exterior in the case of temporo-sphenoidal abscess is both shorter and more direct.

The tendency shown by the pus to return by the avenue through which the infection has entered the brain, also a point Macewen draws attention to, is only what is to be expected,

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the tissues along that route being already partially, if not entirely devitalised, and often indeed disintegrated.

Turning now to the effect of leakage upon the clinical aspect of brain abscess, we find considerable variety. At one extreme is Case I above in which the abscess formed, ruptured externally, and evacuated itself, without attracting any attention whatever. It was apparently well on the way to natural cure when we accidentally happened upon it. How often brain abscess so entirely latent occurs, it is, of course, impossible to say. Then we have the state of matters described by R. Ritchie Rodger in one of his cases, in which a subdural abscess of the frontal lobe continued to discharge externally for as long as four years without causing any brain disturbance whatever, the drainage permitting an equilibrium to become established between the local resistance and the invading infection. Thus leakage occasionally prevents the usual increase in intracranial pressure with all its dangers.

In most of the cases recorded, however, not only was the external discharge remarked and watched, but the symptoms gave positive and definite evidence of increasing intracranial pressure, ultimately necessitating operation on the brain. That is to say, the relief afforded by the leakage is seldom sufficient to neutralise the pressure effects of a brain abscess, or to keep its bulk from enlarging, or its infection of the brain from extending. As Gordon Berry's case in particular shows, rupture into a ventricle may actually occur in spite of a leak. The reason is, as Macewen points out, that the channel through which the pus is finding its way out is usually narrow and tortuous, and is liable to become obstructed, and even completely blocked by granulations. Very seldom indeed is the drainage through it sufficiently free to lead to the complete evacuation of an abscess and its spontaneous cure.

There is, besides, another factor in the situation we must not overlook, namely the relative virulence of the infection. As we all know only too well, even the most effective drainage will fail at times—usually in acute infections—to keep the disease in the brain from extending, and what the surgeon's wide open drainage fails to effect we can scarcely expect a narrow convoluted fistulous pipe to provide. For that matter, to combat such virulence something more than drainage is necessary.

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With regard to the character of the discharge, the following points may be noted. Its onset is usually sudden and coincides with relief to pain and headache. It is generally copious and persistent, the quantity being apparently greater than can be produced by the mastoid and middle-ear spaces alone. The pus composing it is thick and not infrequently fœtid. Such discharge may, of course, merely betoken a large extradural abscess. And indeed, for that matter, in many of the recorded cases there was an extradural abscess present as well as a brain abscess, the pus finding its way from the brain through the dura to begin with, and then through the bone of the cranial wall, a two-stage journey which itself shows how slow, partial, and uncertain the natural method of drainage is apt to be. In some of the cases, again, the extradural abscess had almost certainly been present from the first invasion of the cranium.

Thus the differential diagnosis between a large leaking extradural abscess and a brain abscess will often be difficult, and may be impossible, until the patient is on the operating-table, unless in the event of brain detritus being discovered in the pus. In any case, the importance at operation of submitting the dural covering of all extradural abscesses to careful scrutiny requires no emphasising.

The sudden relief to intracranial pressure when a brain abscess ruptures externally is, as we have seen, manifested in the almost immediate disappearance of pain and headache. Sometimes also the more definitely localising symptoms and signs—aphasia, paralysis, and so on—vanish in like manner. Or, as we have also observed, continuing leakage may altogether prevent the onset of such symptoms. But in most of the cases, while the pain apparently did not return, the other pressure and paralytic phenomena did. Or again, as in Case III above, although the headache did not re-appear and focal signs were absent, yet the patient failed to withstand the infection of the brain.

Nevertheless, although leakage seldom leads to spontaneous cure, it tends to moderate symptoms and to retard the progress towards a fatal issue. Its beneficial effect is apparent in the case-mortality, our figures, as far as they go, showing that external rupture is, as we might expect, a fortunate accident. Thus of our thirteen cases, nine recovered and only four died. The point is that operation on a brain abscess is more likely to end in recovery when it is leaking than when it is closed.

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The Leaking Brain Abscess

It might be supposed from what we have seen to be the characteristics of a leaking brain abscess that its *diagnosis* would be an easy matter. Nevertheless, as the following case shows, we may be misled.

CASE V.—A woman aged 40, a person of unusual vivacity and intelligence, developed acute otitis media and mastoiditis on the left side. The meatal discharge was scanty and there was, as in Case II, severe left-sided headache centring in and above the ear. The cortical mastoid operation was at once performed. As a result, all her symptoms were relieved for about three weeks and then a recurrence of the earache and headache took place and the temperature rose a little. Two days later the mastoid was re-opened, but no new focus was found. Ten days later, the pain continuing, Mr. Sydney Scott saw her in consultation. Her temperature was then running a sub-normal but oscillating course with a range of one and a half degrees F. His opinion concurred with my own that we should temporise. Four days later a sudden and copious discharge of pus from the meatus gave immediate relief to her pain, but raised in my mind fears of extradural or brain abscess. After the discharge had been watched for a fortnight an exploratory radical mastoid operation was undertaken. The antro-tympanic roof was seen to be sound, as was the dura of the middle fossa when it had been exposed. So no further exploration was made in that direction. But the tympanum was full of granulations, and bare bone could be felt on probing the tympanic orifice of the Eustachian tube. A few days before the operation the Wassermann reaction, taken at the patient's suggestion, was reported to be " doubtfully positive". After the operation she was put on Potass. Iodid. and Hydrarg. Perchlor. Six weeks of this treatment led to the sudden cessation of all pain and discharge and to a rapid recovery.

Thus the relief of severe earache and headache by a sudden, copious, and persistent purulent discharge is not necessarily proof positive of intracranial abscess.

In conclusion we have now to consider what influence the existence of leakage may have upon *treatment*. As we have seen while symptoms may be so mitigated by the leakage that the evolution of the disease is spun out—" diluted with time " as the saying goes—nevertheless, as a rule, its progress continues to be downwards, and the end, though delayed, is seldom in doubt. Consequently, sooner or later the surgeon must intervene to improve drainage ; and the first question he has to answer is : When ? For, if there is risk in temporising, there

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is also risk in interfering, and the decision as to the most favourable moment may call for a nice balancing of *pros* and *cons*. Much may depend upon the actual quantity of pus discharged, but more will depend upon the patient's general condition and particular symptoms. Relief to headache and to pain, even when complete and lasting, is not sufficient to justify a relaxation of vigilance, for brain abscess may progress painlessly to a fatal issue.

The second question may arouse some surprise. It is: Where should the surgeon seek to drain the abscess? The answer to that is: Where it is leaking. But the answer requires definition.

In most cases, as we have seen, leakage occurs by way of the abscess-stalk, and in these the operation would in no wise differ from what has come to be the usual method of draining all brain abscesses due to aural or nasal sinus suppuration. But when leakage is going on at some out-of-the-way spot, as, for example, through the squama or the greater wing of the sphenoid, should not the surgeon ignore the fistula, and content himself with drainage through ear or nasal sinus as the case may be, leaving the fistula to close of its own accord?

Perhaps there would not be much difference in the results either way, but the following points would seem to be worthy of consideration before deciding. First of all, it is not wise to ignore the selection by Nature of a certain point for drainage. Secondly, leakage, wherever it occurs, leads to the formation of a sinus with more or less firm and resistant walls. That is to say, there is around the track an inflammatory zone shutting off the infected from the uninfected meningeal and brain tissues. Presumably therefore within the limits of this area the surgeon can make his incisions and insert his tubes without much risk of spreading the infection. Finally, as R. Ritchie Rodger has pointed out, the apparently out-of-the-way fistula may really represent the site of origin of the abscess, and the stalk may actually be situated at that spot.

In any case, however, it would probably be wise to combine drainage through an outlying fistula with drainage through the apparent site of origin, whether nasal sinus or ear. Or the fistula might be selected to begin with, and, if it failed to give the necessary relief, the original site could then be tried.

There is no need to say that when leakage is taking place through some inaccessible region, as in Macewen's case through

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the posterior condylar foramen, one would have to be content with making a direct opening into the abscess.

As for the operation itself, safety would seem to consist in keeping as much as possible within the confines of the inflammatory zone around the discharging sinus, where, we may suppose, reactionary defences exist. But just how far we may transgress those limits in any particular case, it will often be difficult to determine. We may say, however, that if, by an exposure of the fistulous opening in the bone and dura, and the removal of such bone and granulations as are damming up the pus, we can provide sufficient room for drainage, further interference with its additional risk would seem to be unnecessary. On the other hand, as the recorded cases show, the opening through the dura is often so small that its enlargement is imperative. The extent of the incisions would then depend upon the necessities of drainage, and the risk of spreading infection would have to be faced.

When all is said and done, if the surgeon can offer sufficient drainage to the abscess without too rashly encroaching upon the adjoining meninges and brain, he has done all that can be expected of him. The issue will thereafter rest upon the relative virulence of the invading organisms, and so far will lie beyond his control, as things are at present.

Whether or not a drainage tube or tubes should be inserted may also at times be matter for consideration. If the leaking sinus is short, its track wide, the flow of pus easy, and if there are no indications of intracranial disturbance, then a tube may safely be dispensed with. When, however, the surgeon has found it necessary to enlarge the track, a tube will be indispensable to maintain its patency, since without a tube the brain matter, diffluent as porridge almost, would close in upon the unresisting sinus and obliterate it.

The still unsurmounted difficulties attendant upon the attempted drainage of brain abscess, whether by means of tubes or otherwise, do not come within the scope of this paper.

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In dieser Arbeit lenkt der Verfasser die Aufmerksamkeit auf 13 Fälle, bei denen eine andauernde Eiterung aus dem Ohr auf den Spontandurchbruch eines Hirnabszesses zurückgeführt werden konnte. Dass Hirnabszesse in die Ventrikel oder Meningealräume durchbrechen und das Zerebrospinalsystem mit virulentem Eiter überfluten, wodurch in wenigen Stunden der Tod herbeigeführt wird, ist bekannt. Die latenten Formen solcher Abszesse mit Durchbruch der Eiterung nach aussen und entsprechenden klinischen Folgeerscheinungen sind aber viel weniger bekannt.

In den meisten angeführten Fällen wurde nicht nur die Ohreiterung bemerkt und überwacht, sondern auch aus den allgemeinen Symptomen ergaben sich positive und bestimmte Anzeichen für den wachsenden intracraniellen Druck und schliesslich die Notwendigkeit einer Hirnoperation. Allerdings ist dies nicht immer der Fall und manchmal ist die genaue Diagnose äusserst schwer. Die Behandlungsweise der verschiedenen Formen wird ausführlich geschildert und besondere Vorsicht in Bezug auf die Ausdehnung der Inzision und die dadurch bedingte Gefahr der Ausbreitung der Infektion empfohlen.

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Dans cette communication, l'auteur relate treize cas où la cause d'une suppuration persistante de l'oreille a été trouvée dans la rupture spontanée et l'évacuation d'un abcès du cerveau. Chacun connait l'abcès du cerveau, qui, s'ouvrant dans les ventricules ou les espaces ménigés, inonde le système cérébro-spinal avec un pus virulent et aboutit en quelques heures à la mort. Mais peu de médecins connaissent la formation latente, la rupture et l'évacuation externe de ce genre d'abcès, et toute la série d'incidents cliniques qui en résulte.

Dans la plupart des cas cités, non seulement l'évacuation externe a été remarquée et observée, mais les symptômes ont également donné une preuve positive et définitive d'une augmentation de la pression intra-cranienne, nécessitant finalement une opération sur le cerveau. Les choses ne se passent pas toutefois toujours ainsi et parfois le diagnostic est extrêmement difficile. Le traitement dans les diverses formes est donné en détail et l'auteur met en garde contre les incisions trop larges et le risque de répandre l'infection.

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