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BALTIMORE

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CLINICAL AND OPERATIVE DATA *

CHARLES BAGLEY, JR., M.D.

BALTIMORE

For ten years I have been accumulating data in the form of clinical notes and pathologic specimens of brain abscess, and for the past year have studied this material, gleaning facts and recording personal experiences with the hope of combining forces with other workers toward the finding of a common ground for clinicians in the management of these troublesome cases. The serious state of patients when presented for treatment, the difficulty in making decisions concerning operations, and the high mortality rate in reported cases all indicate a lack of precision which we should endeavor to overcome. Gradually increasing interest in surgical conditions of the nervous system has exerted a good influence, but a review of the literature and a survey of one's clinical experience force the admission that our cures of brain abscess today, like the cures twenty-five years ago, are more or less accidental, and in many cases merely a question of luck.

In spite of the fact that the cerebral function may be entirely restored and there need be no recurrence of the lesion, that ever present phantom in tumor cases, this malady is feared, and patient and physician often abandon hope at the first sign of involvement. The present dread of the condition seems justified when we consider that the mortality rate in a series published in 1922 was 75 per cent.; it will be remembered that Sir William McEwen, in 1893, reported eighteen recoveries in nineteen patients operated on. I feel that the recovery in McEwen's series will not be equaled until our methods of diagnosis rid the surgeon of the necessity of performing eleventh hour operations in obviously hopeless cases.

* Read before the joint meeting of the Section on Surgery, General and Abdominal, and the Section on Nervous and Mental Diseases at the Seventy-Fourth Annual Session of the American Medical Association, San Francisco, June, 1923.

"Do you believe the diagnosis could have been made earlier?" is a usual question after all operations for brain abscess. The physician then looking backward is anxious to determine whether he has deprived the patient of a chance for recovery. In the light of operative findings, one is always forced to acknowledge that more attention should have been paid to certain symptoms observed during the few days or even weeks before admission to the hospital. It is often difficult, of course, to differentiate between symptoms of the primary inflammation and those due to the brain abscess. Fear of the presence of an abscess frequently prevents the physician from facing the extremely unpleasant situation until the appearance of grave symptoms. A headache after mastoid operation, for instance, is discounted until it becomes very troublesome and associated with other evidence of intracranial involvement. The period between initial and advanced symptoms varies from a few days to several months, but in either case the operative procedure is likely to be postponed until demanded by the patient's condition.

In looking over our histories with abscesses secondary to otitis media, mastoid and accessory nasal sinus inflammation, we find that the shortest interval between the initial symptom and the drainage of the abscess was three weeks.

CASE 1.—R. W., a girl, aged 15 years, had left otitis media beginning Dec. 1, 1913. The left mastoid was drained, December 9. The condition was favorable until Jan. 7, 1914, when she had frontal and temporal headache, vomiting, and very severe dizziness and diplopia, and these symptoms were still present, January 27. The patient was stupid, and her general physical condition poor. There were ataxia of the left upper and lower extremity, and bilateral choked disk. There was no nystagmus. The temperature and pulse rate were slightly above normal. A left cerebellar hemisphere abscess was drained, January 28, but the patient died suddenly, forty-eight hours later. The course was short, but it is probable that there was a circumscribed collection of pus in the left hemisphere several days before operation, so that nothing was gained in waiting. If serious signs of compression had not appeared, the operative procedure would have been further postponed.

CASE 2.—E. B., a girl, aged 8 years, had severe pain in the left ear, Jan. 11, 1914. A paracentesis was done, January 21, but as the symptoms continued, the left mastoid was opened,

January 24. She had a slight chill with a sharp rise of temperature to 102.2 F., January 30. The temperature gradually returned to normal three days later, and was subnormal, February 8, at which time vomiting commenced; dizziness was first complained of, February 10. Examination by a neurologist on this date showed normal disks and coarse nystagmus to the left; functions attributed to the temporal, occipital and parietal regions were not disturbed; adiadokokinesis and some ataxia were present on the left. The diagnosis of left cerebellar abscess was made but was not concurred in by the physician in charge, as he considered the condition due to inflammatory involvement of the labyrinth. Examination, March 15, revealed marked choking of the disk, leaving no doubt about the diagnosis. The advice was not accepted, however, until the condition became very serious, March 30, when the abscess, due to staphylococci, was drained; the patient made a complete recovery.

This patient's life was spared because the organism producing the infection permitted delay between the time when a positive diagnosis of abscess was possible and the undertaking of the proper surgical procedure.

Abscesses must frequently be differentiated from neoplasms, encephalitis and meningitis. The history of a primary inflammation in the adjacent cavities or pulmonary suppuration is valuable, but I have been misled in tumor cases to believe that there was an abscess because of the presence of such suppuration. The rapidity of the progress of symptoms, usually greater in cases of abscess, is helpful, but this rule is not entirely trustworthy, as tumors may produce symptoms over a period quite as brief as that sometimes seen in abscess.

CASE 3.—E. T. E., a man, aged 43, was seized March 16, 1915, with severe headache in the occipital region, a few weeks after a severe attack of grip. After the first headache he was free from pain for several days, when it recurred, accompanied by vomiting, dizziness, disturbance of speech, confusion of ideas, difficulty in walking, choked disk and diplopia, and within six weeks from the sudden onset of symptoms his state was very grave. Because of the attack of grip and rapid development of symptoms, the disturbance was believed to be inflammatory. Aspiration for abscess was negative; a decompression for relief of pressure was done, after which progress was very slow and a diagnosis of tumor was made. This patient died a little less than eight months after the beginning of symptoms, and the necropsy showed an extensive infiltrating glioma, involving the right frontal and temporal lobes, and basal ganglions on both sides.

The difficulty of differentiating encephalitis from brain abscess has been strongly encountered in some recent cases.

CASE 4.—R. F., a man, aged 22, during the course of a mild attack of influenza suffered with severe headache which necessitated his leaving the train on which he had been traveling for twelve hours. The following day he resumed his journey, but the headache continued and was always very severe, and fourteen days later there developed weakness of the left face, weakness of the left leg, jerking of the muscles of the left shoulder and fingers of the left hand, and very slight postcervical rigidity. The reflexes were exaggerated on both sides, with ankle clonus, positive Babinski and suggestive Kernig sign on the left side; all were negative on the right. Hyperesthesia was very troublesome over the left side of the head, neck, left upper extremity and two fingers of the left hand. The ophthalmoscopic examination was negative. In the early part of the course, the pulse rate was as low as 52 a minute, and the temperature was subnormal at times. The leukocytes were 26,000, with 90 per cent. polymorphonuclears. The cerebrospinal fluid contained 14 cells per cubic millimeter. Sixteen days after the sudden onset, under local anesthesia and through a trephine opening, an exploring needle was passed in various directions into the right parietal lobe, resulting in negative findings. The patient died forty-eight hours later, and the necropsy revealed an acute meningo-encephalitis.

An interval of eighteen days between the initial symptom and death in this case gave a period quite as long as that sometimes seen in abscess cases. The negative needle exploration of the parietal lobe made the diagnosis of encephalitis possible, and certainly did no harm.

CASE 5.—G. B., a girl, aged 13 years, was admitted to the hospital, April 27, 1923, with symptoms of mastoiditis following left otitis media. A mastoid operation was performed, April 28. The postoperative course was satisfactory until May 18, when a severe convulsive seizure occurred following pain in the right arm, with marked weakness of all muscles of the right side of the body, including the face. The deep reflexes of the right side were increased; there was also definite incoordination on the right side. Headache was present, but not severe. Ophthalmoscopic examination revealed definite overfilling and slight tortuosity of the veins and slight obscuration of the margins. Moderate postcervical rigidity and a positive Kernig sign were present. A diagnosis of intracranial inflammation, probably abscess, was made. The left temporal and lower portion of the parietal lobe

were aspirated, but no pus was found. The postoperative course was very satisfactory except for a convulsion three days after the operation. Examination, June 15, showed marked improvement, with negative fundi and full recovery of motor power. No elevation of temperature, disturbance of pulse rate or headache occurred.¹

Similar cases have been seen, but the absence of choked disk, high temperature range and pulse rate made diagnosis possible without aspiration.

The differentiation between abscess and meningitis is often difficult and always of great importance. The effort on the part of the physician to arrive at an exact diagnosis often leads to lumbar or ventricular puncture, a most dangerous procedure when an abscess is present. In cases of suspected abscess, lumbar puncture will of course give definite information concerning meningitis; but unless the meningitis is due to *Diplococcus intracellularis*, nothing will be accomplished. To overlook this type of infection would rob the patient of a chance of recovery, but the balance of evidence should be in favor of meningitis, when the puncture may be undertaken for the purpose of confirmation. One hesitates to call attention again to the danger of lumbar puncture in patients with a high degree of intracranial pressure, but I do so because what has been accepted about lumbar puncture in brain tumor cases is often lost sight of by the physician when dealing with inflammatory conditions.

CASE 6.—H. T., a girl, aged 16 years, was admitted to the hospital with the history of a discharging ear for a number of years and an intracranial involvement for several weeks. An abscess was suspected, and with the view of gaining a full knowledge of the case before consultation, a lumbar puncture was done at 3:30 in the afternoon. At 4 o'clock the respiration and pulse rate were definitely disturbed; at 6 p. m. there was cessation of respiration and loss of consciousness, and the pulse was full and bounding. During artificial respiration an hour later, there was spontaneous evacuation of about 50 c.c. of thin, foul pus from the auditory canal, so that nothing further could be accomplished by aspirating the abscess. Five hours after the cessation of breathing, a cerebellar decompression was done with the hope of relieving what was believed to be a jamming of the medulla and cerebellum into the foramen magnum. When the cere-

1. This patient was examined eleven weeks after operation and found to be entirely free from neurologic disturbance. It is probable that symptoms noted were due to a local encephalitis which did not go on to suppuration.

bellum was uncovered, pressure cones were found extending from each hemisphere into the vertebral canal, a distance of 4 cm., so that it was necessary to remove the laminae of the first and second vertebrae to relieve the pressure on the medulla. The patient died twelve hours later. Necropsy revealed a firm wall temporal lobe abscess, with stalk leading from the tympanic cavity.

The symptoms present were sufficient to establish a diagnosis of brain abscess; lumbar puncture was unnecessary and only added another and more serious condition. A second danger of lumbar puncture lies in the change of cerebrospinal pressure and the likelihood of rupture of the abscess into the ventricles or the subarachnoid space.

CASE 7.—Another case of interest in differentiation in diagnosis between primary inflammation and possible intracranial involvement was that of M. C., a school boy, aged 18 years, who had been operated on several years before for mastoiditis on the right side. Postoperative recovery was good and his condition caused no concern until March 28, 1923, when sudden acute pain in the right ear required paracentesis. Free drainage of the ear followed, but two days later he was dull and rather stupid. At midnight, April 1, he was seized with convulsions, which lasted for two hours until temporarily relieved by chloroform anesthesia. Examination revealed normal fundi and rapid pulse, but no evidence of focal disturbance. In the absence of symptoms of abscess, and as the illness had been so brief, an intracranial exploration was not advised. The mastoid was opened by Dr. E. A. Looper at 3 a. m., April 1. A convulsion had occurred immediately prior to the operation. Extensive necrosis of the mastoid was revealed, but the dura was not exposed. The postoperative recovery was entirely smooth and the patient was discharged, April 16. June 1, the wound was completely healed, and the patient was entirely free from adverse symptoms.

It is still too early entirely to rule out abscess in this case, but the prompt subsidence of symptoms after operation justifies the opinion that the disturbance was merely irritative.² In borderline cases of this type, one is often led to do lumbar puncture fearing the presence of meningitis. There must have been a very narrow margin between the extracranial and intracranial inflammation, and I am of the opinion that a lumbar puncture would have favored a meningeal extension.

2. Neurologic examination of this patient more than four months after operation (August, 1923) revealed nothing abnormal.

Correct localization of an abscess is almost impossible if the neurologic examination must be made in a patient too dull to cooperate with the examiner. The value of an examination is well shown in the following case:

CASE 8.—R. H., a boy, aged 7 years, was operated on, in the middle of August, 1922, for left perirenal abscess, the cause of which was not determined. Postoperative recovery was satisfactory as concerned the abscess, and the wound healed in the usual time. One week after operation, the boy had a very severe convulsive seizure followed for some days by marked disturbance of speech; two months later there was a second but less severe convulsion, followed by slight aphasia. During the winter months his condition caused no concern, and slight disturbances, such as dizziness when stooping, were attributed to his previous illness. Early in March, 1923, he had severe headache definitely localized in the left frontal and anterior temporal regions, followed by evidence of increased intracranial pressure. Because of clouding of the left frontal sinus, the diagnosis was that of left frontal lobe abscess. A neurologic examination was made, March 25, at which time the child was restless and complained of left frontal headache so severe that at times it caused him to cry out. During intervals of pain he was cooperative, making possible a complete neurologic examination. The most important facts were high grade choked disk, slight right facial weakness, and right homonymous hemianopia. The making of perimetric charts was not possible, but by repeated examination with various objects, including a coin, the presence of the visual defect was definitely established. This alone led to the proper localization of the abscess, which was immediately drained. Forty-eight hours later there was complete relief of all signs and symptoms except hemianopia, which disappeared in three weeks.

Hemianopia was also the sole sign of localization value in Case 9, in which the original diagnosis was cerebellar abscess:

CASE 9.—R. L., a man, aged 27, entered the hospital five weeks after a sudden attack of dizziness which had continued so troublesome that it was almost impossible for him to sit up. Headache was very severe, the gait unsteady, and high grade choked disks were rapidly increasing. There was some incoordination on the right. In the left occipital region there was an area of bone necrosis, the cause of which was not determined. This area was drained, but the symptoms continued and the cerebellum was aspirated with negative results. Several weeks later he developed a right homony-

mous hemianopia; the abscess was located in the right occipital lobe. Although the patient recovered, there has been no improvement in the hemianopia.

CASE 10.—C. H., a man, aged 50, had hemianopia several weeks before other symptoms were observed. This was discovered while the patient with his family was on a trip through the Gettysburg battlefield, when he found that he was not seeing objects to the right of him. No attention was paid to the defect, and just before admission to the hospital there



Fig. 2.—Section through optic nerve and disk (Weigert-Pal preparation); slightly reduced from a photomicrograph with a magnification of 8 diameters.

was a sudden increase of symptoms, and the patient died of meningitis. Though a necropsy was not permitted, the clinical course suggested a slowly increasing abscess, which ruptured into the ventricle, causing meningitis.

The ophthalmoscopic examination has been helpful in all cases of long duration, and in Case 1, in which the entire course was only three weeks, there was well advanced bilateral choked disk. The early appearance

of choking in this case was perhaps largely due to internal hydrocephalus produced by the cerebellar abscess. In some cases of temporal lobe abscess there was no choking when the period of involvement was

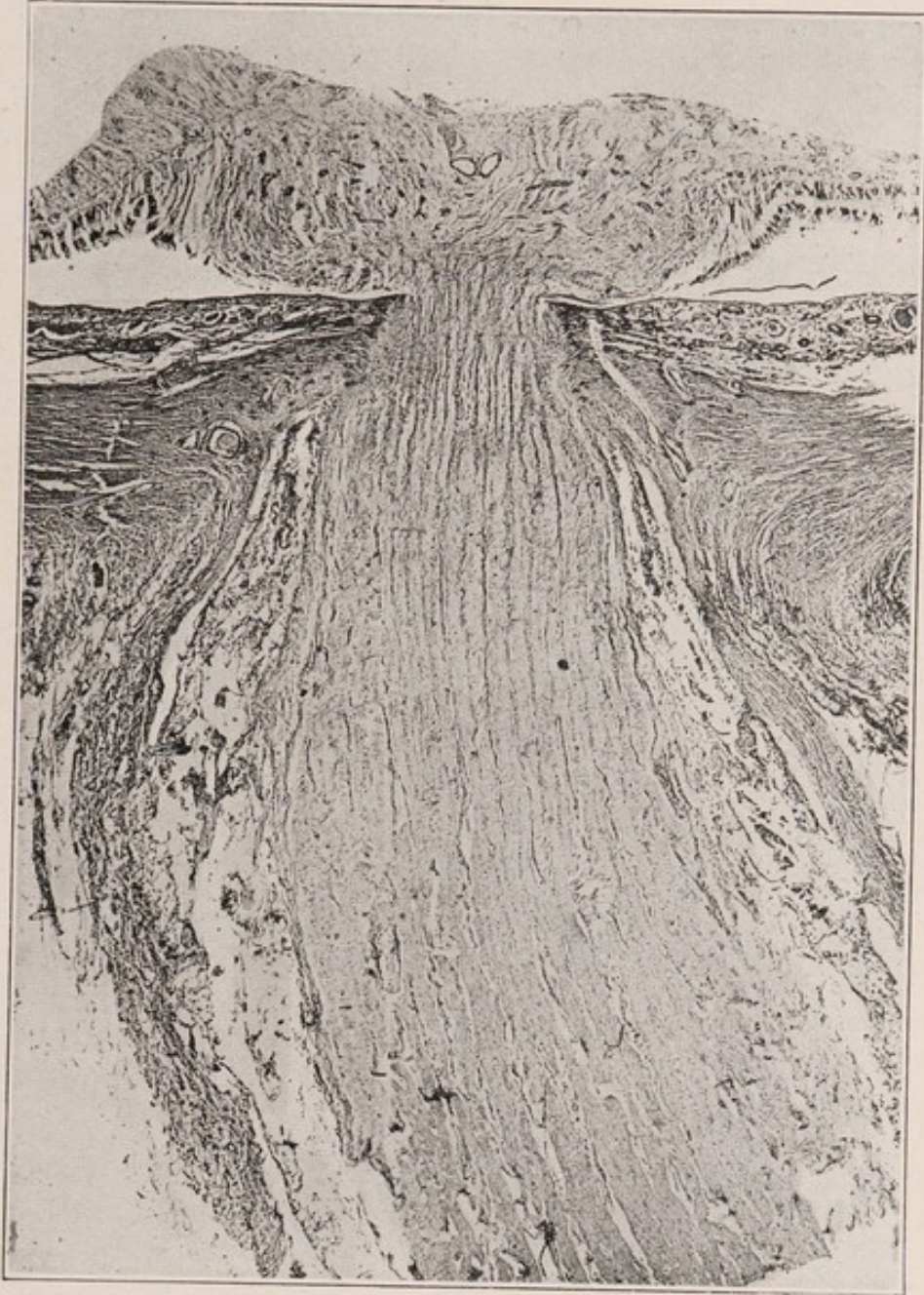


Fig. 1.—Section through optic nerve and disk (hematoxylin and eosin preparation); reduced from a photomicrograph with a magnification of 20 diameters.

even longer than three weeks. An extreme degree of choking is shown in Figure 1, a photograph of the nerve head in the case of a young woman (L. F.) who had a frontal lobe abscess with definite symp-

toms for a period of two months. The opposite is seen in Figure 2, L. H., who had symptoms for a period of a month, when a convulsive seizure occurred and he suddenly died. Necropsy revealed a very large abscess in the left parietal lobe.

The wide difference of opinion as to method in evacuating a brain abscess indicates the chaotic state of surgical procedure directed toward the relief of the condition. There is, of course, no one method applicable to all types of cases, but it is not likely that the chosen mode in a given type should vary from a small trephine opening to a large bone flap plus ven-

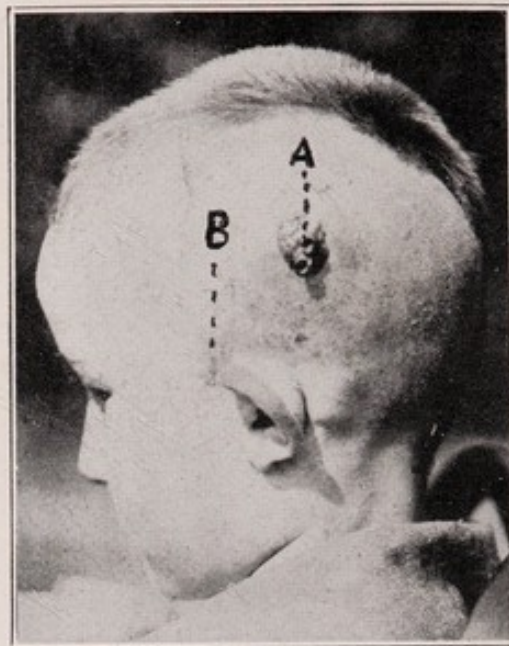


Fig. 3 (Case 8).—Appearance ten weeks after drainage of an abscess: *A*, original drain in small granulating wound; *B*, site of first negative puncture.

tricular and lumbar punctures. After a study of the pathologic specimens³ and a full appreciation of the effort of the brain to surround the invading infection by a limiting membrane, I developed a great respect for the abscess wall and determined to avoid any interference with its function. Operative procedures, therefore, must prevent any breaking of the abscess wall. Large explorations through a bone flap cause distortion and sometimes even extrusion of the wall. To rid the brain of the entire cavity would seem an ideal procedure were it not for the fact that the area

3. Bagley, Charles, Jr.: Brain Abscess with Pathological Observations, Surg., Gynec. & Obst., to be published.

immediately outside the wall is often the seat of inflammatory changes, and another abscess or diffuse encephalitis may follow.

The distortion of the brain which follows decompression makes this a very bad procedure in brain abscess, as it favors rupture of the membrane, with escape of pus into the ventricle, subarachnoid space or brain tissue.

In the usual type of deep brain abscess, the most simple drainage of the cavity through a small opening



Fig. 4.—*A*, fragment of a high explosive shell, the site of a temporal lobe abscess; the fragment was later removed; *B*, a small, split rubber tube placed through the floor of the abscess into the middle fossa of the skull after section of zygoma.

as near the bottom as possible, I believe, gives the best results. The opening in the skull and dura should be only large enough to accommodate the drains, thereby preventing herniation. At the initial operation, a goodly portion of pus can be evacuated without danger of collapse of the wall, and drains should be placed well into depths of the cavity. The drainage material should be selected with a view to prevent deterioration if left in for a number of weeks, and it should be flexible to insure adjustment to the gradually contracting abscess wall. Folded rubber protective drains without gauze

and split rubber tubes meet these requirements. When drainage is established in this way there is no post-operative reaction, and the care of the patient consists in changing the outside dressing at frequent intervals.

The original drains should be left in place until there is practically no pus, at which time one may feel that the abscess cavity has been converted into a small sinus immediately surrounding the drains. If these have been satisfactorily placed free drainage will begin



Fig. 5.—Appearance fourteen weeks after drainage of a temporal lobe abscess through the original mastoid incision. The small rubber tissue drains placed in the wound at the time of operation were still in position.

by the fourth or fifth day. This interval is necessary for the establishment of the tract, because the original evacuation has relieved some of the pressure and a reaction must occur along the course of the drains. In one patient with a temporal lobe abscess, about ten days after the operation there was a visible ebb and flow of pus at the external opening of the drains, synchronous with the heart beat, and the flow could be increased by coughing. This seemed to indicate a normal pressure relation, as the flow was similar to

that seen in a needle when the normal ventricle is punctured. With this type of drainage, all symptoms disappeared.

During the first few days, some manipulation may be necessary; but, when drainage has been established, only the outside dressings should be changed. As the wall contracts, the drains may be extruded a few millimeters a week after the first three or four weeks. To provide for this slight extrusion and to prevent injury of the abscess wall by the inner end of the drains, a mishap not to be overlooked if split rubber tubes are used, the drains should be cut close to the scalp, and dressings applied about them so as to pre-

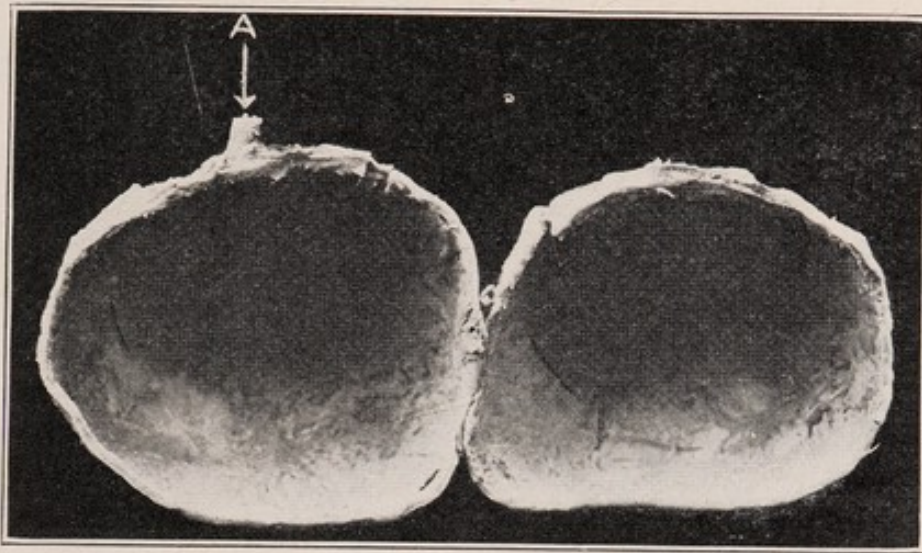


Fig. 6.—Bisected abscess sac with thin wall; A, pedicle forming communication between the abscess and an area of skull necrosis.

vent pressure on their outer extremities. Any such procedure as sewing to the scalp to prevent extrusion should be avoided.

Figure 3 shows a small granulating wound with small split tube drains leading to a large abscess of the left hemisphere in Case 8. A scar in the lower left temporal region marks the site of the first aspiration, which was negative. As this was a metastatic abscess, there was no adjacent sinus inflammation to lead one in selecting a point of drainage, so that an effort was made to evacuate the abscess at its lowest portion. When the first puncture was negative, it was evident that we were below the lesion, and the higher puncture gave positive results.

Gravity is a most important aid in drainage of abscesses, and should always be considered in the placing of drains. The inability to drain frontal lobe abscesses from the bottom constitutes one of the chief obstacles in the management of this type. This difficulty was forcibly brought to our attention in one of our fatal cases.

Figure 4, reproduced from a roentgenogram of E. M., who had a large left temporal lobe abscess, shows a rubber tube drain placed through the floor of the middle fossa into the bottom of the abscess. This point was selected for drainage because the metallic foreign body producing the abscess had entered through the malar bone, and the proximal part of the original tract was used for drainage. Recovery followed this procedure.

G. S. S. had a left temporal lobe abscess of three and one-half weeks' duration. The left mastoid also was involved, and during the mastoid operation, which preceded the abscess drainage by four days, the otologist, Dr. M. L. Breitstein, noted that the dura was exposed above. With this knowledge, and the open mastoid wound, drainage of the left temporal lobe abscess through the original incision was simple. As this abscess was due to a *Streptococcus hemolyticus*, thorough drainage with very little operative trauma was essential. The photograph reproduced as Figure 5 was made three and one-half months after the operation, and there was practically no drainage of pus, although the small protective drains were still in position.

The after-care of the patient is very much more important than the operation, and all the dressings during the period of free drainage should be done by one person, that there may be no division of responsibility in having the drains remain in position. It may be necessary to continue drainage for three or four months after the operation, but the course is otherwise simple and there is little risk of having the infection light up after an apparent cure.

This method of drainage is not useful in cortical abscesses occurring at the site of smashing skull injuries, when liberal drainage is usually demanded. It has been shown that the protective reaction in cases of this type establishes a firm fibrous tissue barrier;

and, if care is taken to avoid injury to the membrane, a very free drainage can be established without danger of herniation.

A patient had a large left temporal abscess, the result of bone fragments driven into the cortex by a butcher's cleaver, six weeks previous to the operation, which consisted in removal of the bone fragments and the filling of the cavity with rubber tissue drains. Free drainage continued for three months, and a small drain was allowed to remain for a longer period. Recovery was complete.

In another case, fibrous tissue containing the bone fragments was removed in mass, leaving an area of unprotected brain. Into this area ruptured a second abscess, the presence of which was not previously known, and a diffuse encephalitis resulted, followed by death. In an exactly similar case, drainage was done without interfering with the fibrous tissue wall, and the patient recovered.

The occasional success following extirpation of the abscess wall is due to a particular type of abscess, as shown in Case 9. The abscess was of long duration, and when right homonymous hemianopia determined its location, an effort was made to aspirate the pus. A ventricular puncture needle, passed through a trephine opening, encountered the dense fibrous tissue wall, but even with firm pressure failed to penetrate the wall. We then believed that we were dealing with a tumor, and a bone flap was turned down. When the mass was removed and held in the operator's hand, a small pedicle about the size of the radial artery was found to be patent, and the slight pressure of the hand caused pus to exude. A study of the wall of this abscess showed it to be made up entirely of fibrous tissue, and it was classified as a pedunculated dural abscess. The postoperative result was entirely satisfactory, but I believe that we should not be led to practice this method, which entails the removal of the protective membrane and exposes the brain to any organism, and may result in a diffuse encephalitis.

It is with a great deal of interest that I sum up the results of our efforts in the twenty-four cases studied. The abscess was verified by operation or necropsy in all but one case. Of the number, three patients died without operation; twenty-one were operated on, of whom twelve recovered and nine died,

giving a recovery rate of more than 57 per cent. Among the patients who recovered, three are under treatment in that drains are still in the wound, but all are out of the hospital and entirely free from symptoms. In the most recent case, the patient was operated on, May 3, 1923.⁴

The three patients not operated on who died were so seriously ill when admitted that it was evident that operation offered nothing. The condition was far advanced in all the fatal cases; in some instances meningitis was known to complicate the abscess and the operation was undertaken as a last resort.

The twelve patients who recovered were seriously ill, and each at some time or other during the course caused us much anxiety.

SUMMARY

Brain abscess, still one of the most serious of cerebral lesions, requires prompt diagnosis and precision in treatment. The diagnosis often depends on some very obscure sign or symptom. Many patients, when admitted, are in such condition that errors in judgment as to time or method of procedure may determine the issue.⁵

The Latrobe, Charles and Read streets.

4. These patients were examined in August, 1923, and found free from neurologic symptoms. In two cases, the tracts were healed; the third was draining satisfactorily.

5. This work was done in the Neurological Laboratory of the Phipps Psychiatric Clinic, Johns Hopkins University, and has been greatly facilitated by the interest and cooperation of Dr. Adolf Meyer. I am indebted to Miss Cecilia Bisson for the photographs.

