

CRANIOTOMY AND TOTAL DISSECTION AS A METHOD IN THE TREATMENT OF ABSCESS OF THE BRAIN*

EDGAR F. FINCHER, M.D.

ATLANTA, GA.

FROM THE DEPARTMENT OF SURGERY, EMORY UNIVERSITY SCHOOL OF MEDICINE, EMORY UNIVERSITY AND ATLANTA, GA.

THERE are no recorded experiences in the literature where a purposely planned surgical attack has been made to completely resect every gross vestige of a demarcated abscess located within the brain tissues. The idea of total extirpation of such an abscess is not a new concept. Such reports refer only to those experiences in which the abscess has been removed *in toto*.^{1, 2, 3} The recoveries in these cases have been ideal. Where a rupture occurred,⁴ or there was wound contamination, the serious complications, sequelae or protracted hospitalization, as have happened with all other of the numerous surgical methods in treating brain abscesses, have followed. The few experiences to be cited here suggest that when intact removal is impossible that complete dissection with the patient fortified⁵⁻⁸ against an infectious-spread may be a better method than incision and drainage, simple aspiration or marsupialization efforts. It is physically obvious that dissection efforts in a "diffuse infective encephalitis" or "a pus-containing cavity with ragged wall consisting of softened brain tissue" (Sargent¹) would not be considered as suitable cases. For these, systemic treatment and the recent experiences of Furlow,⁸ using penicillin, offers an optimistic hope that in the future better results may be accomplished in these cases than has been accomplished in the past. The author, as has almost every other neurologic surgeon, has had the rare experience of removing a "brain tumor" *in toto*, to learn later that the central cavity of the very thick-walled granuloma contained bacterially active pus. Again, the treatment of these, although fundamentally it does not differ, is not within the scope of this communication and is purposely omitted. Before the introduction of the sulfa derivatives and penicillin, the opening of a pus-containing lesion at the time of a craniotomy immediately brought forth the fears of a meningitis, prompted immediate drainage and, if a postoperative fatality was escaped, it usually meant a subsequent sacrifice of the osteoplastic flap, rather likely a cerebral fungus formation, and a prolonged hospitalization necessitating daily care and constant attention. Although the first case in this series was prompted somewhat by virtue of a necessity, the other four have reacted so favorably it is proposed to add subsequent cases in order that an accurate evaluation and comparison with other methods of treatment may be accomplished.

CASE REPORTS AND COMMENTS

Case 1.—A boy, age 4, was taken ill with bilateral earache on December 10, 1941. Three days later the left drum was incised and sulfathiazole by mouth begun. There was no aural drainage. On December 17, he developed pneumonia, and the left ear began to

* Read before the Fifty-seventh Annual Session of the Southern Surgical Association, December 4-6, 1945, Hot Springs, Virginia.

drain pus. The pneumonia rapidly cleared. On December 20, a diagnosis of mastoiditis was made; this diagnosis was confirmed at operation two days later. He was discharged from the hospital on December 30, apparently well.

February 7, 1942: His mastoid wound had healed and he had no complaints. The following day he complained of headache and the day after this he had an associated forceful vomiting accompanying the progressive headaches. On February 10, a motor aphasia developed, and within 24 hours a complete right hemiplegia was present. On February 12, a left temporal abscess was aspirated; three days later tube drainage was instituted.

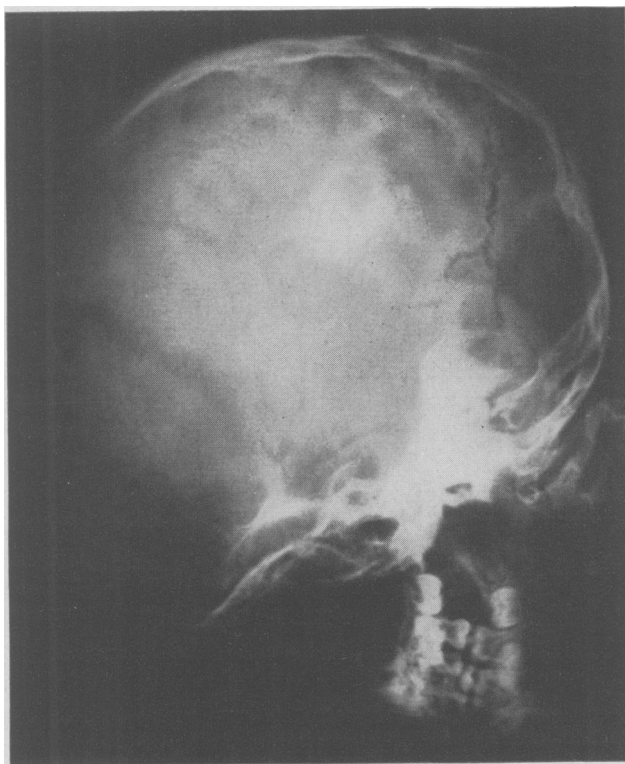


FIG. 1.—Showing the previous trephine skull defect through which the thorium dioxide was injected into the abscess cavity. This media only permitted visualization of the most superficial cavity.

The neurologic symptoms rapidly disappeared and by April 1 the wound had healed and the child again was discharged from the hospital. Ten days later all the neurologic symptoms recurred and, again, on April 17, tube drainage was instituted, but this time the aphasia, hemiplegia and projectile vomiting failed to clear. The attending neurosurgeon was called to military duty and the child was referred for further neurosurgical evaluation. With each reappearance of symptoms or temperature elevation this child was given sulfathiazole.

Physical Examination.—April 27, 1942: The patient was a lethargic, emaciated, acutely ill, irresponsive child. There was a bulging defect in the posterior temporal area on the left, with an encrusted scab in the center of a 1.5-inch surgical scar. This elevation was soft to palpation but exhibited no free pulsations. There was a bilateral choking of both optic nerves. Right hemiparesis was demonstrable. No conversation could be elicited from the child.

Aspiration and Thorium Injection.—April 29, 1942: The old left temporal scalp scar was excised. An abscess was entered with a ventricular needle less than 1 cm. from the dural level; approximately 60 cc. of pus was aspirated and 10 cc. of thorium dioxide was injected into the abscess cavity. Culture of the pus resulted in a growth of influenza bacilli.

Treatment and Progress.—Sulfadiazine by mouth was administered daily, and a blood level of 9.8 mg. was maintained. Three days after aspiration drainage, speech had returned and the right hemiparesis was disappearing. On May 5, the spinal fluid pressure was over 300 mm. of water and the fluid contained 27 cells per cubic centimeter. The thorotrast shadow, which, on April 29, was visualized as a cortical shadow in the middle portion of the temporal lobe, had shifted, by May 4, to a more posterior position and nearer to the midline (Fig. 1). The bulging scalp became more tense and the herniation increased the scalp elevation.

Craniotomy-Dissection of Multilobular Abscess.—May 9, 1942: The former wound was transformed into an enlarged hockey-stick scalp incision. The original trephine opening was enlarged with the bone rongeurs to a diameter of 5 cm., exposing the posterior midparietal, the anterior midoccipital and the superior posterior temporal lobes. The gangrenous edematous cerebral fungus was sacrificed with the cautery. The abscess stalk was a part of the cerebral fungus, so that an abscess cavity was immediately entered. This abscess cavity harbored an ounce of pus, and when this had been thoroughly and repeatedly irrigated and its location thoroughly established, this cavity did not correspond to the thorotrast outline on the roentgenogram of May 4. A small dural flap was then turned down and an exploratory needle introduced in a new area superior to the exposed cavity. At a 2.5-cm. depth a new resistance was encountered. The initial abscess capsule was then dissected from out of the white matter and in its superior as well as posterior limits a dumb-bell effect was encountered. Each of these continuities with the surfaced capsule broke into separate abscess cavities, each being as large as the first. As the pus was removed by suction, dissection of the respective capsules was carried out by traction on these capsule walls with cotton pledget stripping of the adjacent white matter. The removal of this triple-lobed abscess left a remaining hemispheric cavity that extended well forward under the parietal area, almost to the left occipital pole and into the major posterior two-thirds of the left temporal lobe. With such a sacrifice of underlying tissue a complete closure of the dura, including the original trephine defect, was easily accomplished. The scalp was sutured in the usual two-layer manner without drainage.

Bacteriology.—Gram-negative diplobacillus. Culture: Bacillus influenzae.

Postoperative Course.—The child's condition on leaving the operating room was extremely critical, although intravenous fluids and citrated blood had been administered throughout the procedure. Following a third transfusion the recovery from shock was satisfactory. Continuous intravenous Hartman's solution was maintained for three days. Sulfapyridine intravenously was administered (3 grains per pound body weight) daily for three days. On the seventh day after operation the child was able to take food, fluids and medicines orally. A blood level of sulfa, never below 21 mg., was maintained until May 27, a total of 18 days. On May 21, the lower end of the scalp wound began to bulge and a spontaneous rupture, with an abundance of purulent drainage, occurred. A drainage tube was easily inserted beneath the scalp. Into this tube a continuous drip of five per cent sulfanilamide solution was maintained. The tube was forced out of its subscalpular position by June 4, following which, complete granulation healing occurred. The child was discharged from the hospital on June 13, with normal speech, a right homonymous hemianopsia and a partial right hemiplegia. The paralysis had cleared by August, 1942, and the child has remained well since hospital dismissal. The illness, including the period of treatment extended over a period of 184 days.

COMMENT.—The problem which this patient presented was that the more orthodox neurosurgical procedures had been unsuccessful and, if a cure was to be effected, more radical efforts would be necessary. The lesion as outlined

by the thorium dioxide⁹ was visualized as being more posterior and considerably larger than the skull defect, so a larger bony exposure, with cortical uncapping to allow the lesion to "surface," was initially considered. With the hope that the preoperative fortification with sulfapyridine might prevent a meningitis or a spreading encephalitis, it was decided to extend the trephine opening to craniotomy-size and perform a total dissection of the lesion. The consistency of the capsule had been estimated from the duration of the illness and confirmed at the time of the injection of the contrast media. In the process of removing the overlying edematous cerebral cortex, the stalk of the abscess

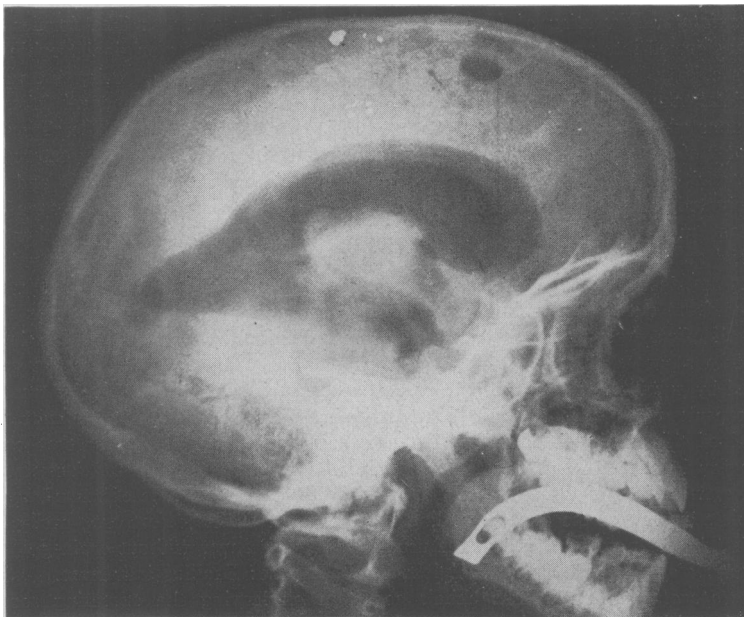


FIG. 2.—The right hemiparesis and the absence of any cerebellar objective symptoms suggested a left temporoparietal abscess. The acquired symmetrical internal hydrocephalus outlined by ventriculography excluded this clinical location.

was opened with the cautery and the pus evacuated by suction. Although the capsule had been extremely resistant to the ventricular needle puncture, the wall proper was rather friable, so that its removal was somewhat in piecemeal. The cavity was entirely medullary white brain matter except for a small raw 1.5-cm. mass on its mesial wall. This was very firm to palpation and when punctured with an aspirating needle 20 cc. of pus was drawn into the attached syringe. This cavity was entered after the exposed projection had been opened (1 cm. core) with the cautery. It was possible to hold this capsule with the pituitary cup-forceps and dissect the entire sac except for what appeared to be a posterior attachment. This attachment was severed and the delivered capsule had 3-cm. openings on both ends. The "attachment" remaining proved to be a third cavitation of pus and when this had been opened, its contents

removed by suction and dissected free from the brain, there remained only a brain cavity surrounded entirely by the white matter.

The failure of the orthodox efforts might well be explained on the multilocular character of the abscess. The thorium visualization demonstrated the presence of but a single abscess and that one the most superficial. The initial aspiration (February 12, 1942) did improve the child's general condition but free drainage was necessary before any neurologic improvement occurred. It was reported that the amount of pus recovered at the time of the insertion of the first drainage tube was comparable to that amount which was aspirated 70 hours previously. The surgical efforts instigated prior to the radical dissection illustrate the long tedious difficulties that every one has had, at least once, in any worth while series of abscess experiences. The total period of illness to date of hospital discharge in this case was 184 days. The hospitalization of the radical abscess removal was 37 days.

Case 2.—A 12-year-old girl was taken ill, in April, 1942, with a complaint of bilateral earache. The left ear promptly began draining. Two weeks later mastoid pain on the left side appeared and the child's temperature became elevated above the normal. She was then given sulfa medication orally. Her temperature returned to normal after three days, but she began to complain of frontal headaches and there occurred early morning projectile vomiting. A spinal puncture was performed followed by symptomatic relief. On June 14, the headache and vomiting returned; the child complained of a photophobia and a diplopia. A brain abscess was suspected, and the child was referred for neurosurgical study.

Physical Examination.—June 21, 1942: The patient was a lethargic, listless child, whose physical appearance was very good. She consistently lay on her right side, shielding her eyes from the light. Neck flexion offered some pathologic resistance. Both optic nerve heads were swollen to four diopters elevation. There was a left external rectus palsy. There was a right facial weakness. The left arm and leg were more facile than the right extremities. All the deep reflexes were hyperactive. Roentgenograms of the skull were only pathologic for a left mastoid disease "with destruction of the left petrosal cells."

Ventriculogram—Aspiration of Abscess.—June 24, 1942: Frontally performed ventricle air injection outlined an acquired internal hydrocephalus of all the supratentorial cavities (Fig. 2). Following the ventriculogram the left occipital bone was trephined and a left cerebellar abscess was aspirated of 40 cc. of pus. Ten cubic centimeters of sulfanilamide solution was injected into the abscess cavity before the aspirating needle was removed.

Bacteriology.—Gram-positive coccus. Culture: Type-III pneumococcus.

Mastoidectomy.—June 30, 1945: Dr. Lester Brown performed a radical mastoid operation. Free pus was encountered when the petrosal tip was unroofed. The recovery from this was effective but the intracranial symptoms continued in a progressive manner.

Cerebellar Craniotomy—Dissection of Abscess.—July 17, 1942: A left unilateral suboccipital scalp flap was hinged inferiorly. The previous trephine opening was enlarged to a bone sacrifice of the entire left occipitocerebellar skull. The dura was reflected. A cerebellar cortical sacrifice of 2.5 cm. was made from the "stalk" of the previous aspiration site. The abscess was opened and its contents, of some 40 cc. of thickened pus, removed, by suction. Grasping the friable capsule with the cupped tissue forceps, folding it into the cavity made possible by the uncapping and aspiration, the mass was easily stripped from its engulfing cerebellar substance. This was accomplished by cotton pledget wedging dissection. The tip of the abscess, when removed, permitted identification of both the fifth and sixth cranial nerves. Three grams of sulfanilamide crystals were powdered into the remaining cerebellar cavity, the dura was resutured and the scalp closed in

layers without drainage. A 250 cc. citrate transfusion was administered, and the child left the operating theater in good physical condition.

Postoperative Course and Treatment.—There was a comfortable, gratifying convalescence. Sulfapyridine in three grain dosage per pound body weight per 24 hours, was begun on the first postoperative day and was continued for a total of 16 days. Free pulsations continued in the operative area throughout the remaining hospitalization. The mastoid wound had healed by August 1, and, on August 7, her neurologic symptoms and findings had disappeared. On this date she was discharged from the hospital, and she has remained well (Fig. 3).

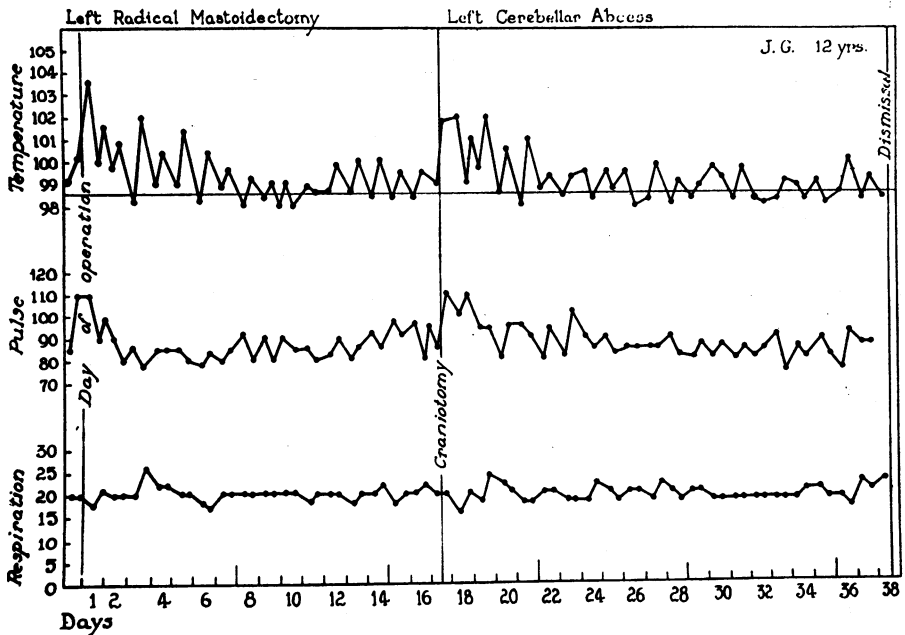


FIG. 3.—The clinical chart of the entire hospital period in Case 2.

COMMENT.—The increased intracranial pressure in this patient presented the most serious problem, so that following pneumoventricular localization, aspiration of the abscess appeared wiser in anticipating the radical mastoidectomy. This one fundamental in the treatment of brain abscesses is so important that a deviation from the purpose of this communication seems justifiable. Unless the focus of the abscess is abolished before, or at the time the brain abscess is treated, a cure may not be effected. A recurrence of the abscess is to be expected and, when the focus is within the bony structures, osteomyelitic processes are likely to develop. The aspiration in this case permitted an omission of any emergency efforts, and allowed effective convalescence from the petrosal infection. Further, it was demonstrated at the time of the craniotomy that in this particular case aspiration alone would not have been adequate treatment for a cure. Forty cubic centimeters of pus was removed at that time. Twenty-three days later, at the time of the craniotomy, an equal amount of pus was removed when the abscess cavity was opened. Both specimens con-

tained Type-III pneumococci. It is to be recalled that sulfanilamide had been injected into the abscess at the time of aspiration. The local application of sulfanilamide, undoubtedly, prevented an encephalitic-meningitic process, and allowed primary wound healing. The systemic sulfa therapy unquestionably complemented this topical treatment in obviating these infectious complications.

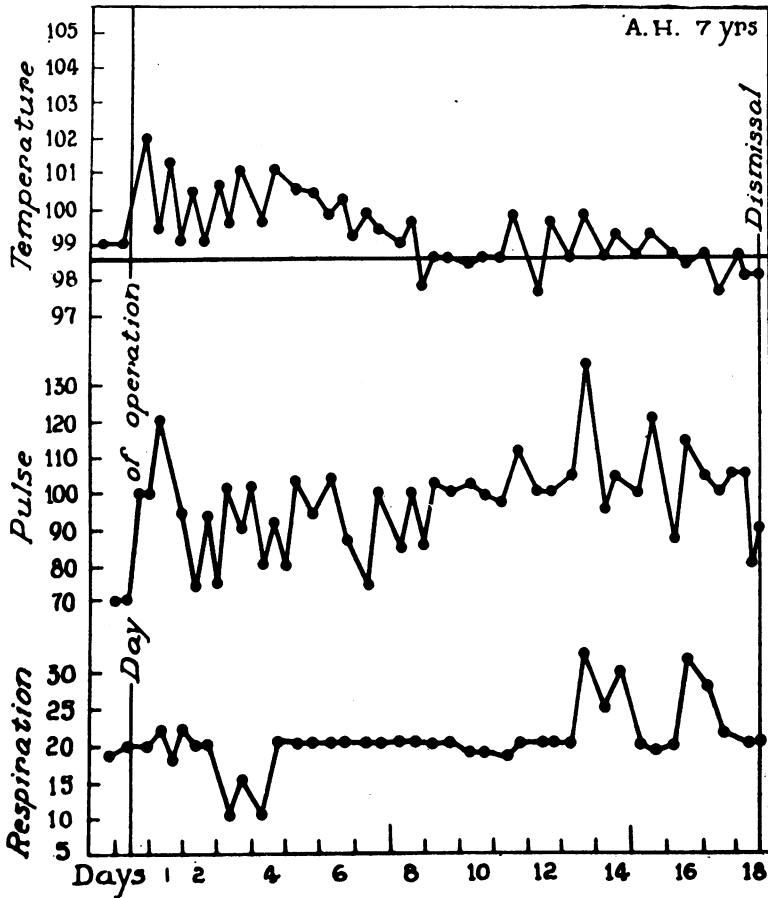


FIG. 4.—Convalescence was unmarred, and the patient was permitted to be out of bed on the 13th postoperative day.

Case 3.—A seven-year-old girl had the onset of her illness on December 18, 1943 with influenza. She was ill for four days and then began to have headaches. This was subsequently associated with a postural type of vertigo. She then developed generalized weakness and became rather listless, and there occurred a handicap in the use of her right arm and leg. Although she was normally right-handed she “preferred to use her left hand.” January 25, an associated vomiting attended her more severe headaches.

Physical Examination.—February 4, 1944: Temperature 99.3°F . Pulse 110. She was very fretful and uncoöperative. Physical development was very good. Bilateral choked disks and motor weakness of right arm and leg were noted. The abdominal reflex was absent on the right. There was generalized hyporeflexia without demonstrable pathologic reflexes. The right ear drum was injected and there was a tenderness over the right mastoid tip. Roentgenograms of the skull and mastoids were normal.

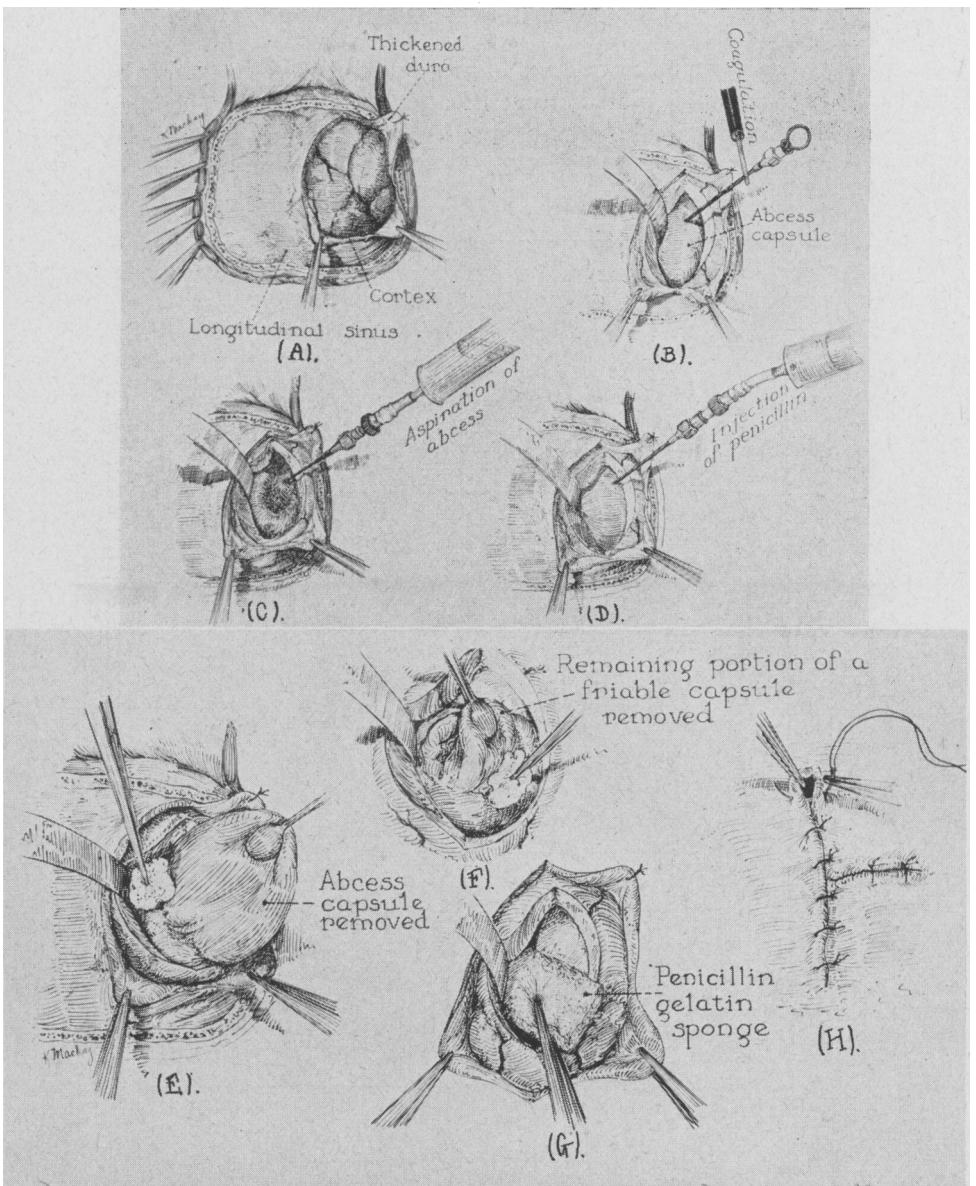


FIG. 5.—A. When the cortex has been exposed the depth of the abscess is determined by the exploratory ventricular needle.

B. The overlying cortex may be transected or a circumcisectional uncapping performed to give an adequate exposure of the dome of the abscess. The exposed cortex and medullary brain are protected with cottonoid strips soaked in penicillin. The abscess is punctured under electrocoagulation.

C. Syringe aspiration of the cavity for gaining space for capsule dissection and for specimen collection minimizes wound contamination as compared with open suction methods.

D. The total amount of penicillin solution injected is for less than the volume of pus aspirated. The needle is withdrawn under electrocoagulation.

E. The small opening made by the aspirating needle is closed with the cupped forceps and, if possible, this traction-hold is maintained throughout the capsular dissection.

F. The friability of the abscess wall or the size of the lesion may necessitate piecemeal dissection. This is accomplished best with cotton pledget dissection, folding the abscess wall into its own cavity.

G. Gelatin sponge strips soaked in thrombin and then penicillin are placed in the medullary cavity. They are useful in sealing an opening into the ventricle cavity should such an accident occur in the dissection.

H. The dura is sutured tightly as in routine craniotomy following a tumor removal.

Ventriculogram.—February 4, 1944: Frontally performed ventricular air injection outlined a symmetrical dilation of all of the ventricular cavities above the tentorium.

Cerebellar Craniotomy—Dissection of Abscess.—February 4, 1944: Through a cross-bow exposure the cerebellum and first cervical spinal cord level was exposed. The right cerebellar lobe was full and the lamellae broadened. An exploratory needle introduced into this hemisphere encountered a resistance 1.5 cm. from the cortex surface. This resistance was that of a tennis ball. A split was made in the cortex and the surface of a soft demarcated mass was inspected. The upper outer one-third of the cerebellar cortex was then sacrificed, exposing a domed mass for an area of 2.5 cm. A ventricular needle was introduced into the cavity of the mass with the aid of electrocoagulation. As the stylet

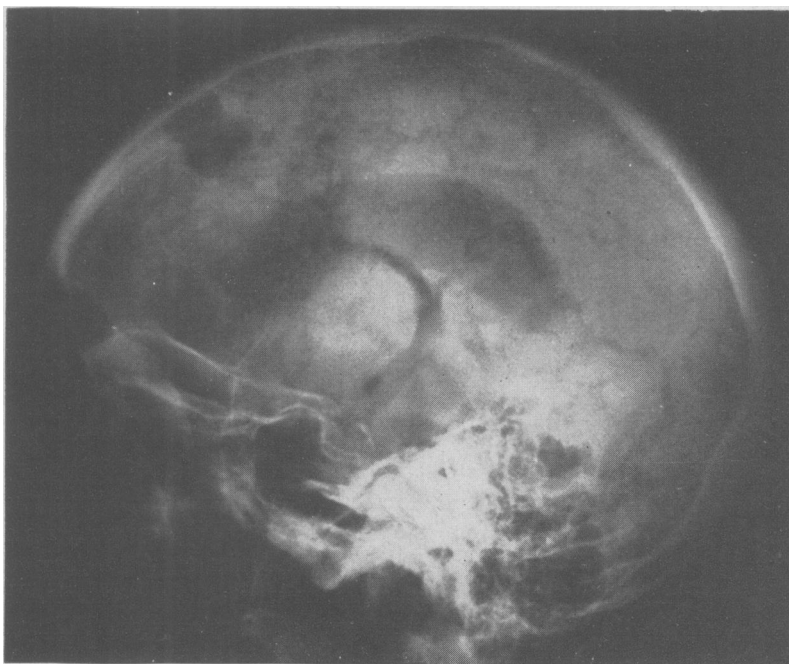


FIG. 6.—The clear-cut ventricular deformity of the right cavity suggested a demarcated rather than an infiltrating lesion as was clinically suspected.

from the needle was withdrawn, syringe suction was immediately applied to the end of the needle and no free pus allowed to soil the exposed field. After a collapse of the abscess from suction, the opening was closed with the pituitary cup-forceps, and this hold on the abscess capsule gently maintained throughout the dissection. With cotton pledget wedging dissection the adjacent cerebellar substance was detached from the pathologic lesion. To gain room for the continued dissecting process it was necessary to reinsert the aspirating needle through the original puncture wound as it was necessary to aspirate the pus on two subsequent efforts. The final dural attachment of the capsule was at the petrosal dura. A four-centimeter cavitation was left when the entire abscess wall had been removed. Two grams of sulfanilamide was sprinkled into the bottom of the cavity and an additional 25,000 units of penicillin was injected into the same area. The dura was closed tightly, as were the muscle layers, deep and subcutaneous fasciae. Two hundred and fifty cubic centimeters of citrated blood was given intravenously, and the child's condition was most satisfactory upon completion of the operation.

Bacteriology.—A gram-positive coccus. Culture: *Streptococcus viridans*.

Postoperative Course and Treatment.—Sodium sulfadiazine in normal saline (2.5 gm. in 500 cc.) was administered intravenously each day for three days. She was then given one gram of sulfadiazine by mouth every four hours for the ensuing ten days. The skin sutures were removed after 96 hours. She was out of bed, walking, with no handicaps, on February 20, and was discharged from the hospital on the 22nd, after a total of 22 days hospitalization (Fig. 4). She has remained well.

COMMENT.—This case illustrates the technical maneuvers that were utilized in this and the subsequent two cases (Fig. 5). Completely, to uncap an underlying abscess for an area equal to the greatest diameter of an abscess would always require a sacrifice of a very large area of overlying brain tissue, but by exposing the dome of the abscess (in this case a 2.5-cm. sacrifice) adequate room for aspiration, for grasping the capsule and for dissection is available. The surrounding brain tissue is walled-off with penicillin-soaked cottonoid strips, the distal ends of which are gently inserted between the abscess wall and the adjacent medullary brain tissues. A 3-mm. spot is coagulated on the dome of the abscess and, with the aid of electrocoagulating current, the abscess cavity is punctured with the ventricular needle. Allowing no free pus to spill into the wound, aspiration of the cavity for its full contents is accomplished by syringe suction. This fluid collection is for bacteriologic studies and for a measurable estimate of the size of the cavity. Without removing the needle, once the cavity has been emptied, penicillin is injected into the cavity, the stylet of the needle reinserted and the needle withdrawn under electrocoagulation just in the manner that it is inserted. The needle opening is closed by grasping the now flabby capsule with the cupped tissue forceps. It is desirable that this hold be maintained, but tissue age does not always permit this. If an uncapping of the cavity is done, owing to the friability of the abscess wall, the cup-forceps still remain effective in allowing mild traction on the abscess wall. This is accomplished by having one cup inside the cavity and one outside. With this traction, placing the cottonoid strips deeper as cotton pledget dissection forces the surrounding white matter away from the abscess wall, one encounters no hemorrhage from this bed. Once beneath the greater diameter of the abscess one finds the strips and the intracranial pressure delivering the sac or its final remnants to the surface. Gelatin sponge strips are placed in the rapidly narrowing remaining cavity. The technicalities, from here on, are those of any clean craniotomy, namely, tight closure of the dura, suturing of the osteoplastic flap and layer closure of the scalp without drainage.

Case 4.—A 47-year-old farmer dated the onset of his sickness from January, 1945, at which time a diagnosis of malaria was made. This illness consisted of one chill and one temperature elevation, and the treatment consisted "of three days of sulfa drugs." In February, early morning headaches developed. These were frontal in location, a bit more severe on the right side and infrequently associated with vomiting. Soon after the onset of headaches, he began to stagger, and usually to the left side. There followed a photophobia, a diplopia and a failing memory for recent events.

Physical Examination.—April 30, 1945: The patient was a coöperative, fairly alert adult. Both optic nerves were elevated some three diopters. There was a left facial weakness of central type. There was an incoördination in the use of the left arm and leg.

There was a left homonomous visual field defect. Routine roentgenograms of the skull were only significant in that the pineal calcification was shifted to the left.

Ventriculogram.—May 3, 1945: Frontally performed ventricle air injection depicted a space-occupying lesion in the right posterior temporal area (Fig. 6).

Right Temporal Craniotomy.—May 3, 1945: Through a left temporal osteoplastic flap the volume of the right temporal lobe was exposed. The intracranial pressure was so increased that no free cerebral pulsations were visible or palpable. An exploratory cannula was introduced into the brain substance in the posterior part of the midtemporal convolution and a characteristic resistance was encountered 2 cm. from the cortex surface. With electrocoagulation this resistance was punctured and the stylet of the cannula was removed. Two ounces of pus was aspirated. Penicillin (100,000 units) was injected into the abscess and again with electrocoagulation the cannula removed. Free cerebral pulsations were thus

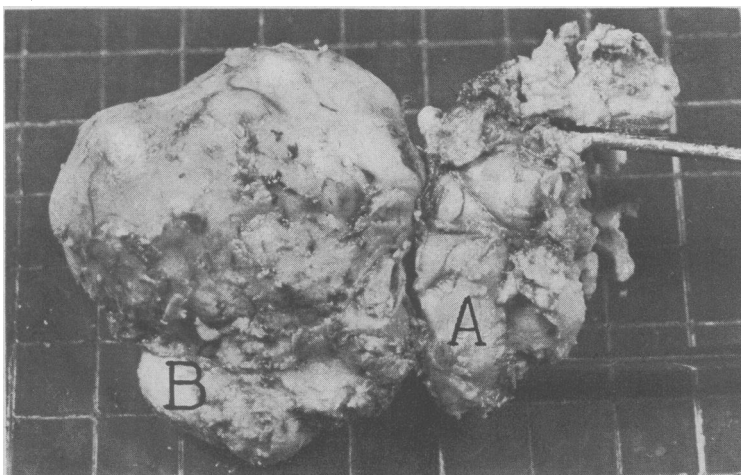


FIG. 7.—The specimens photographed on a centimeter-squared background show the elliptical "cortex cap," A, which sacrifice was necessary to expose the dome of the large abscess, B.

established and the dura was reflected for the area of its exposure. The midtemporal convolution was broadened and pale. A 3-cm. circumcission (Fig. 7A) was made about this convolution and at a depth of 2 cm. in the white matter the smooth dome of the granulation mass was displayed. With cotton pledget-wedging maneuvers the capsule was caught with the cupped forceps. It was too friable for worth while traction so that the dome was excised with the electric current. By folding the walls of the abscess into its own cavitation and with gentle retraction, complete freeing of the base was permitted (Fig. 7B). During this dissection, on the mesial surface of the abscess, a small opening was made into the lateral ventricle. The bleeding from the surrounding medullary brain substance was indeed minimal. Three grams of sulfanilamide crystals was sprinkled into the bed of the intracerebral cavity. Gelatin sponge strips soaked in penicillin were placed in the bed of this cavity and along its walls. The dura was sutured tightly. Two grams of sulfanilamide were placed outside the dura, the bone flap sutured *in situ* and the scalp closed without drainage.

Bacteriology.—Culture: *Staphylococcus aureus*.

Postoperative Course and Treatment.—The convalescence was not marred by any disturbing upsets. Penicillin (25,000 units) was administered intrathecally every other day for five doses. Intramuscular penicillin was administered every three hours for six days. The highest cell count in the spinal fluid was 509 cells per cubic centimeter from five

studies, and no organisms were cultured from any of these specimens. The patient was permitted out of bed on the 11th day after operation, and discharged, May 21, after a total of 21 days hospitalization. Seen on September 28, the patient was feeling "quite normal," there were no residual palsies, but there was a complete left homonymous hemianopsia.

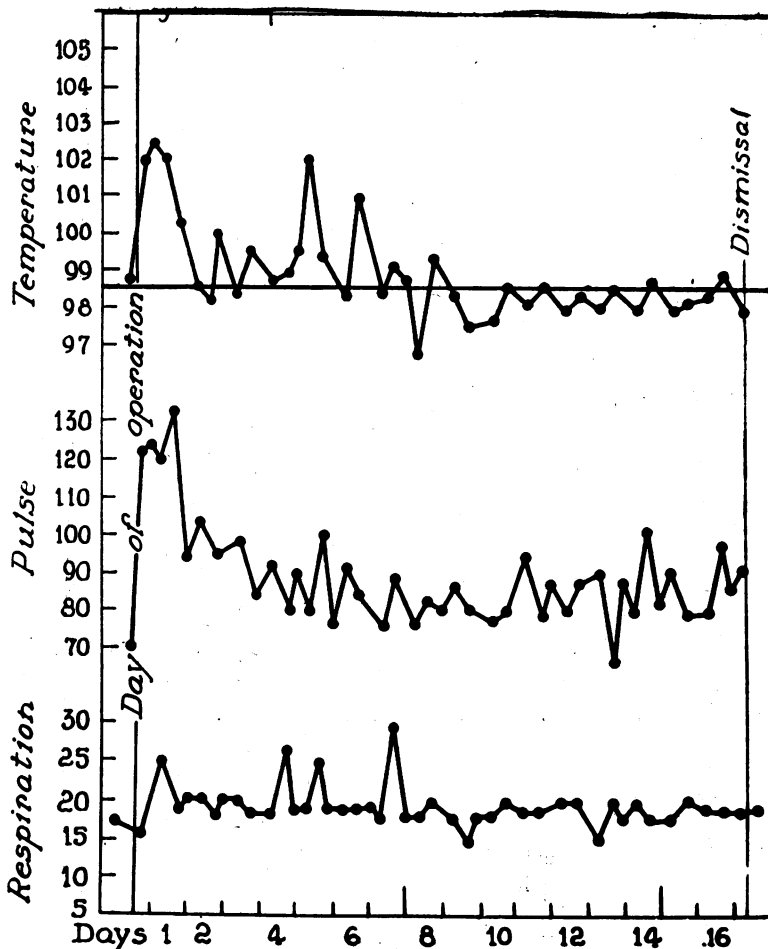


FIG. 8.—This clinical chart could be substituted for any normal convalescent craniotomy in which a benign tumor might have been removed.

COMMENT.—The infectious history in this case was obtained after the pathologic diagnosis had been made. He was considered clinically as a right temporal lobe tumor and, on account of the short history, an histologic diagnosis that his "tumor" was a glioblastoma was made. The ventriculographic depiction was more that of a "demarcated space-occupying lesion" than "that of an infiltrating one." Still, with a tumor diagnosis following the ventricular studies, an osteoplastic flap cortex exposure was performed. There being no lesion visible on the surface, the exploring ventricular needle was utilized. The resistance met by it was the rather characteristic rubbery resistance of an

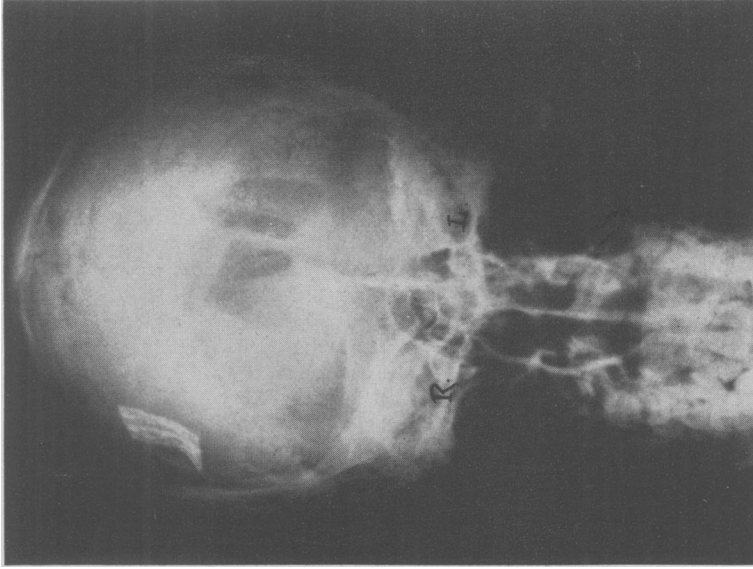


FIG. 10.—The localization in this case was dependent on the defective right anterior ventricle deformity. These studies were performed after radical excision of the osteomyelitis.

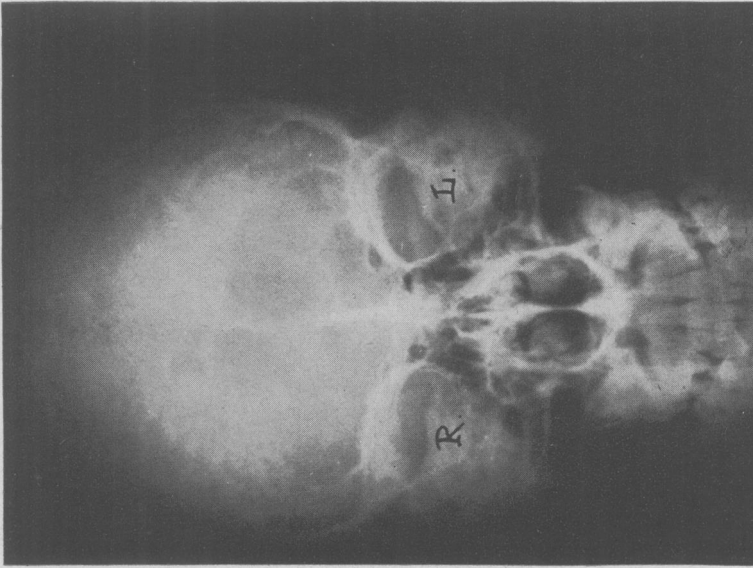


FIG. 9.—The rarefaction of the frontal bones is the radiologic characteristic of osteomyelitis. Note the loss of the detail of the frontal sinus outline on the right side.

abscess, so that an electrocoagulation puncture was made into the abscess cavity. The technical procedures instituted here were those already referred to, and were enforced in every detail. Although the personal experiences of the author, as well as those of many neurosurgeons, before the introduction of sulfa and penicillin therapy, in situations of this type would have prompted a malign prognosis, the experiences in Cases 1, 2, and 3 permitted a more optimistic outlook. The convalescence was that of a normal craniotomy from which a benign tumor had been totally removed.

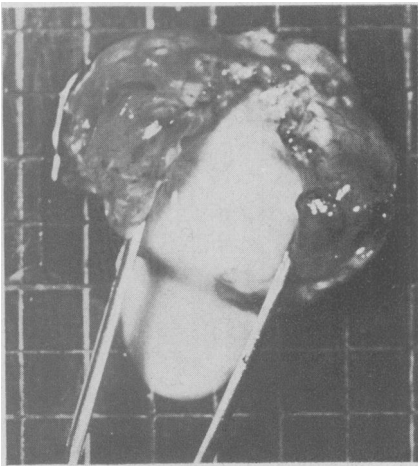


FIG 11.—Although the volume of pus was evacuated during the dissection, when the operative split was opened for photographic detail there still remained a few cubic centimeters.

Case 5.—A 17-year-old boy, in June, 1945, developed a small swelling in the right frontal area, just above the eyebrow. He was told this was a “cyst.” This was incised and pus obtained. This continued to drain, and a similar “cyst” developed over the left frontal area. This too was incised with purulent drainage. In the latter part of July a diplopia developed which was his chief complaint at the time of hospital admission.

Physical Examination. — August 10, 1945: There were encrusted draining wounds in the frontal area. There was a bilateral choked disk of four diopters. There was a left sixth nerve paralysis. There were no other neurologic objective symptoms. Roentgenograms of the skull depicted an osteomyelitis of the frontal bone (Fig. 9).

Radical Excision Osteomyelitis — Bifrontal.—August 14, 1945: A horseshoe-shaped flap was reflected down over both orbital ridges. The right and left frontal

bones were diseased. All grossly infected bone was removed. This left a defect some 7 cm. in diameter. Bilaterally, there were epidural granulations. There were no free cerebral pulsations demonstrable on the right or left side of the exposed sagittal sinus. Penicillin-soaked gelatin sponge strips were laid over the exposed dura. The old scalp incisional sinuses were excised and the scalp was closed in layers without drainage. The wounds healed by primary intention.

Ventriculogram.—August 21, 1945: Posteriorly performed ventricular air injection outlined a large right frontal horn filling defect (Fig. 10). There was a displacement of the superior portion of the anterior third ventricle to the left.

Craniotomy.—August 21, 1945: The previously performed scalp flap was reflected. The granulating dural surface showed no evidence of gross infection. The dura on the right side was opened for the limit of the bone exposure and to the longitudinal sinus, on the mesial side. The convolutions exposed were broadened, bulged above the dural level, and evidenced no free pulsations. An exploratory needle into the anterior pole of the right frontal lobe encountered a resistance 1.5 cm. from the surface. A 2-cm. sacrifice of the cortex was circumcised and the abscess dome bulged into the exposure. The abscess was aspirated of 15 cc. of its pus, and cupping the aspiration opening the capsule was retracted. With cotton pledget dissection and aided by the intracranial pressure, a 3.5-centimeter mass (Fig. 11) was delivered as one would such an intracerebral tumor. The hemorrhage from the bed of the dissection was very mild and easily controlled with

ABSCESS OF BRAIN

bovine thrombin applied with the gelatin sponge packs. These strips were also soaked in penicillin. A total of 100,000 units of penicillin was left within the medullary cavity. The dura was closed tightly. Two grams of sulfanilamide crystals were powdered over the dura, and the scalp was closed in two layers with interrupted black silk sutures.

Bacteriology.—Smear from osteomyelitic skull: Gram-positive cocci. Culture: *Hemolytic Staphylococcus aureus*. Culture brain abscess: *Hemolytic Staphylococcus aureus*.

Postoperative Course and Treatment.—Sulfadiazine, 1 gram every four hours, was given by mouth for eight days. Intrathecal penicillin was given in 25,000 unit dosages



FIG. 12.—Photographed 20 days after abscess removal, healing *per primam* occurred as did this same wound after the radical sacrifice of the osteomyelitis. The stab wounds are the débrided incisions of the former "cyst" operations.

every 48 hours, for four treatments. The highest cell count in these four specimens studied was ten lymphocytes. By September 3, primary wound healing had occurred (Fig. 12), the diplopia had disappeared and the choking of the optic disks was subsiding. He was discharged from the hospital, September 17, 38 days after admission.

COMMENT.—This case doubly illustrates the value of chemo-penicillin as a vital adjunct to neurosurgery. The osteomyelitis was surgically eradicated, the infected dural granulations were covered with gelatin sponge strips saturated first with bovine thrombin, then with penicillin. These strips served not only as carriers for the coagulant material and the antibacteriacidal agent, but served

to obliterate the dead space made necessary by sacrificing the diseased skull. When this wound was reopened seven days later there was no serum collection or gross pus, and healthy granulations were covering the dural exposure throughout. Twenty-seven days after the total removal of the brain abscess the patient was dismissed from the hospital.

TABLE I

Case	Operation	Location	Bacteriology	Treatment		Hospitalization	
				Local	Systemic	Total Days	Days after Craniotomy
I.	Decompression craniotomy	Left temporal	<i>Bacillus influenzae</i>	Sulfanilamide	Sulfapyridine	184	35
II.	Ventriculography radical mastoid. Craniotomy	Left cerebellum	Type III pneumococcus	Sulfanilamide	Sulfapyridine	48	18
III.	Ventriculography. Craniotomy	Right cerebellum	<i>Streptococcus viridans</i>	Sulfanilamide	Sulfadiazine	22	22
IV.	Ventriculography. Craniotomy	Right temporal	<i>Staphylococcus aureus</i>	Sulfanilamide Penicillin	Sulfadiazine Penicillin	21	17
V.	Radical osteo. Craniotomy	Right frontal	<i>Hemolytic staphylococcus aureus</i>	Sulfanilamide Penicillin	Sulfadiazine Penicillin	38	27

The results from the reports in the literature on brain abscesses that have been removed *in toto* have been surgically ideal. These wounds have healed by primary intention, and these patients have escaped the prolonged hospital complications and often fatal results that have followed all other methods of treatment. The follow-up details in these *intact* extirpations are too inadequate to evaluate with any degree of accuracy the latent sequelae, namely, convulsions that have developed following aspiration, drainage, or uncapping methods. In the five cases here reported where radical total dissections have been carried out, aided by sulfa and penicillin therapy, the hospitalization (Table I) period has been comparable to that of a normal convalescence period of any craniotomy and the morbidity, with one exception, has been *nil*. As to latent sequelae, a continued observation will be maintained. The results thus far have been such as to suggest that the basic surgical principle of "incision and drainage" in the treatment of certain abscesses of the brain might be replaced by total abscess dissection and primary wound closure.

REFERENCES

- 1 Sargent, Percy: Drainage of Brain Abscess. *Brit. M. J.*, 2, 271, 1928.
- 2 Vincent, C., David, M., and Askenasy, H.: Sur une methode traitement des abces subaigus et chroniques des hemispheres cerebraux. *Rev. Neurol.*, 49, 1, 1937.
- 3 Odum, Guy L., and Elvidge, Arthur R.: Surgical Removal of Brain Abscess Due to *Bacillus Typhosus* Following Typhoid Fever. *Arch. Neurol. & Psych.* 48: 465, 1942.
- 4 Groff, Robert A., and Grant, Francis C.: The Surgical Treatment of Brain Abscess by Exposure and Enucleation. *ANNALS OF SURGERY*, 107, 925, 1940.

- ⁵ Rowe, Stuart N.: Sulfanilamide in Brain Abscess. *ANNALS OF SURGERY*, 107, 620, 1938.
- ⁶ Bucy, Paul C.: Sulfanilamide in Treatment of Brain Abscess and Prevention of Meningitis. *J. A. M. A.*, 18, 1639, 1938.
- ⁷ Walker, Exum: Use of Penicillin in a Case of Multiple Brain Abscess. *Hawaii*, 4-1, p. 24, 1944.
- ⁸ Furlow, Leonard T.: Penicillin as an Adjunct to Surgery in the Treatment of Brain Abscess. *South. M. J.*, 38-5, 312, 1945.
- ⁹ Kahn, Edgar A.: Contrast Media in Cysts and Abscesses of the Cerebral Hemispheres. *Surg. Gynec. & Obst.*, 74, 983, 1942.

DISCUSSION.—DR. EDGAR F. FINCHER, Atlanta, Ga.: When Doctor Pilcher wrote me of his heroic efforts I could only say I thought he was extremely courageous.

There are many details in his manuscript that must be read to properly appreciate this contribution. In the attempt to discuss it, I find myself stymied by first, an extremely limited experience; and, second, some rather hair-raising mental gymnastics, as I recall, at the operating table when these few experiences were encountered. I think the younger neurosurgeon would do well to read and strictly adhere to Doctor Dandy's publication in 1928* the evening before he plans a craniotomy attack on these lesions.

I can only reemphasize the main indications for operation on these patients: (1) That the lesion be remote in its location to the motor cortices or the left temporal lobe of a right-handed person; (2) that repeated dangerous spontaneous hemorrhages must have occurred; and (3) that uncontrollable convulsions constitute a primary handicap.

I am sure we are cognizant of the fortitude displayed by Doctor Pilcher in his surgical attack in these three cases and will, by virtue of his efforts, be encouraged to offer some hope for those individuals whose lesions meet the afore-mentioned criteria.

DR. WALTER E. DANDY, Baltimore, Md.: If one were looking for the ultimate test of a surgeon's skill, it would be in cases such as this. These are the most vicious lesions in the brain, without any question. His first case is a type that anyone should extirpate; it is in the right occipital lobe where only a hemianopia will result. And the subsequent absence of convulsions has justified his judgment. The extirpation in his second case was practically forced upon him, and a surgeon of less skill would certainly have lost the patient.

I have had only one complete extirpation of such a lesion. One must remember that these lesions are fed by one, sometimes two arterial branches, and from these the blood passes directly into veins or coils of vessels without an interposed capillary bed. The trick of removing these lesions is to go through the brain beyond the lesion and ligate the artery that feeds it. When that is done there will be almost no bleeding.

Certainly Doctor Pilcher deserves a great deal of credit for his fortitude and skill.

In his second case he was fortunate that it was fed by the anterior artery, not by the middle cerebral artery. There are three arteries from which the arterial blood enters the aneurysm, the anterior, middle and posterior cerebral. Those fed by the posterior cerebral are much the easiest to extirpate.

About Doctor Sachs' paper: I think he might have approached this problem in a different light and thereby have been more instructive. Abscesses vary so much in the organisms that cause them, and the results are dependent on the causative organism. So many are multiple, and that complicates the situation. Some are metastatic, others arise by direct extension. The most common organisms are *Staphylococcus aureus* and *Streptococcus*; these are more than half the total number. Single abscesses due to these organisms are easily cured by a single tap and without aspiration or drainage. Following that the abscess resolves and gradually shrinks; in other words, nature takes care of it. With other abscesses the problem differs with the organisms involved; but tapping will not cure them. If the abscesses are multiple the problem is again different and requires more than tapping.

Doctor Fincher has some nice results with extirpation. I have done several when I have encountered them unexpectedly, and with success in most of them. I can recall,

* *Arch. Surg.* Vol. 17, p. 190.