Brain abcess of undetermined etiology : report of four cases with recovery / Joseph C. Yaskin [and others].

BRAIN ABSCESS OF UNDETERMINED ETIOLOGY*

REPORT OF FOUR CASES WITH RECOVERY

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IT IS apparent from personal experience and from a review of the literature that in recent years the treatment of brain abscess has been more successful, and that complete, lasting recoveries have followed a correct diagnosis and proper treatment. However, the diagnosis of brain abscess may often be most difficult. In fact, a preoperative diagnosis of brain abscess depends, in the majority of instances, not only upon evidences of the existence of a space-taking lesion in the brain, but also upon the finding of a possible cause for the presence of an abscess. In other words, we do not consider a brain lesion as being an abscess unless we have some definite infectious process which may account for such a lesion.

The etiologic factors of brain abscess have been divided into three groups. Their relative frequency may best be appreciated by reference to the statistics compiled by Evans,[1] and Parker[2] (Table I).

TABLE I

ANALYSIS OF THE CAUSES OF BRAIN ABSCESS IN 216 CASES

(*Evans[1] and Parker[2]*)

(I) Direct Extension				
(1) Otitis media and mastoiditis			109	
(2) Suppuration in nose and accessory sinuses			12	
(3) Following trauma of skull			8	
(4) Invasion of skull by malignancy			2	
Total			131	(Evans)
(II) Hematogenous Spread (Metastatic)				
(1) Intrathoracic suppuration	22		14	
(2) Extrathoracic suppuration	26		6	
Totals	48	(Evans)	20	(Parker)
Osteomyelitis and cystopyelitis were the most common initial lesions in this group. General sepsis occurred in the majority of cases.				
(III) Source of Infection Doubtful or Unknown			17	(Evans)

It is important to emphasize the fact that while the brain abscess usually develops in the course of acute infection in both Groups I and II, it may also

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similarly produced encephalopathy following other anesthetic agents, it is probable that the cerebral damage is the result of anoxemia regardless of the type of anesthetic used. A more complete neuropathologic study in which the question of local vulnerability of the brain in this and the other cases will be considered in a later publication.

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be secondary to an infection that has subsided. This latter etiologic factor was found by Evans as a doubtful source of infection in seven of the 17 cases in Group III. The relative incidence of a preceding infective process in these cases was: Sinus disease, 2 cases; earaches, 2 cases; severe quinsy five months before, 1 case; carbuncle 14 months before, 1 case; and pneumonia followed by a pneumococcic arthritis, 1 case. In ten cases he was unable to determine any causative factor. We have encountered, within a period of nine months, four cases of brain abscess of undetermined etiology. All of them were operated upon and recovered.

CASE REPORTS

Case 1.—E. S., female, age 20, was admitted to the Graduate Hospital, September 12, 1936, complaining of pain in the head and neck, vomiting, and blurring of vision. Her mother died 18 years ago of tuberculosis; other than that her family and past medical history were negative. There was no history of chronic cough, running ears, sinus infection or any other infective process. About three months prior to admission she had had a tonsillectomy performed, under local anesthesia, without any untoward effects. Six weeks later she began to complain of headache and somewhat later of diplopia, loss of vision and vomiting. During the few days preceding admission the pain in the head had become severe. On admission her temperature was 99.3°; pulse, 64; respirations, 22; blood pressure, 118/90. She was mentally clear, had some rigidity of the neck, a bilateral Kernig, a bilateral papilledema of about 3 to 4D, a cut in the left temporal field, weakness of both external recti, more marked on the left than on the right, a paralysis of both seventh nerves, more marked on the right than on the left, and no significant changes in the extremities. The spinal fluid pressure was 350 Mm. of water, and the spinal fluid contained five lymphocytes.

The lumbar puncture relieved the headache for two days, after which it recurred with greater severity. The temperature varied between normal and 99.0° F., the pulse varied between 64 and 100, and the blood pressure remained fairly constant. Uranalyses were negative. The blood picture showed a mild secondary anemia, 12,800 leukocytes, 88 per cent polymorphonuclears. The blood Wassermann was negative. The stools showed ova and segments of *Taenia saginata*; the patient's father recalled that she had had a tapeworm many years before. Roentgenologic examination of the skull and the paranasal sinuses revealed no abnormalities. The lumbar puncture was repeated September 18, 1937, and showed a pressure of over 700 Mm. of water, and the spinal fluid contained 15 cells, but was otherwise essentially negative.

It was felt she had a space-taking lesion, but owing to the confusing neurologic signs, especially the presence of the bilateral sixth and seventh nerve paralyses and the marked increased intracranial pressure without any cerebellar symptoms, localization was difficult.

Operation.—September 19, 1936, by Dr. F. C. Grant: A ventriculogram showed a mass lesion on the right side, probably in the frontoparietal lobe. Accordingly, a right frontotemporal bone flap was reflected. The dura was extremely tense and upon its reflection the sylvian fissure was seen to be pushed up by a mass beneath the surface and within the substance of the tip of the right temporal lobe. A transcortical incision was made over the tumor, which was removed without rupture. It measured 3½ x 4 x 5 cm. The patient made a rapid and uneventful convalescence. All neurologic signs disappeared and she has remained well to date.

Pathologic Examination.—Section of the tumor revealed a capsule 0.5 cm. thick, filled with fibrinopurulent exudate. Microscopic examination of the capsule showed it to be composed of a stout fibrous stroma, in which many short glia fibrils were to be

seen together with numerous blood vessels, many of which showed proliferative changes. Plasma cells, lymphocytes and old polymorphonuclear cells were present.

Comment.—The evidences of increased intracranial pressure pointed to a space-taking lesion, but clinical localization seemed impossible because of the presence of the bilateral combined sixth and seventh nerve paralyses. The clinical findings in this case are almost identical with those occurring in a case of a verified brain tumor reported by Spiller.[3] There was no etiologic factor to suggest the presence of an abscess. The tonsillectomy, three months previously, was not followed by any pulmonary complications, as in the case reported by Gardner,[4] or by any other known infection. Even at operation both this and Case 2 were treated as brain tumors and were removed en masse as in the case reported by Parker.[2] The slow pulse and the severe headache were noted but not duly evaluated.

Case 2.—J. F. M., male, age 26, single, occupation, weighman, was admitted to the hospital of the University of Pennsylvania, January 12, 1937, complaining of severe headache, partial loss of vision in the left eye, pain in the left shoulder and arm, and dizziness and loss of weight. The family and past medical history were irrelevant. On October 1, 1936, without any previous infection or injury, he began to have projectile vomiting. A week later he began to have left fronto-occipital headache. The pain was constant, increased in severity, and by January, 1937, radiated to the right frontal region; in addition he experienced difficulty with vision in the left eye. About November, 1936, he complained of some pain in the left shoulder and arm, became dizzy when bending over, and noted that in walking he tended to swerve to the right. Notwithstanding the loss of approximately 20 pounds in weight, he did not discontinue working until January 10, 1936.

Physical Examination.—The patient was a well nourished male. Temperature, 98° F.; pulse, 64; respirations, 18; blood pressure, 112/60. The general somatic examination was negative excepting for large cryptic tonsils, a postnasal drip and some dental sepsis. The neurologic examination revealed bilateral choking of the optic disks, right 4D, left 5D with hemorrhages; contraction of the visual fields, especially in the right temporal field, suggestive of a right homonomous hemianopia; left abducens palsy; either weakness or dyssynergia of right extremities with a right-sided Trennor-Hoffman sign, a hyperactive right Achilles tendon reflex and an abortive right ankle clonus; some loss of sense of position in the right hand; and some dysarthria. Uranalysis and Wassermann tests were negative. Leukocyte count, 10,600. A spinal tap was not performed. Roentgenologic examination revealed erosion of posterior clinoid processes and the dorsum sellae, with some forward displacement of the top of the dorsum. Roentgenologic Diagnosis: Probably an extrasellar mass lesion. During the period of preoperative observation his pulse varied between 56 and 84 while the temperature and respirations remained normal.

Preoperative Diagnosis.—Brain tumor, either in the left frontal, left occipital or right cerebellar regions.

Operation.—January 21, 1937, by Dr. F. C. Grant: Two trephine openings were made over the tips of the posterior horns of the lateral ventricles. In attempting to tap the right posterior horn, the cannula encountered a firm mass which was thought to be a tumor. Predicated upon this finding a left occipitoparietal bone flap was reflected. A massive tumor, only slightly adherent to the dura, was seen on the surface of the cortex. The mass was removed without rupture of the capsule.

Postoperative Course.—After a moderately prolonged convalescence the patient

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Pathologic Examination.—The mass weighed 65½ Gm. and measured 6 by 4.5 by 3.5 cm. It had a thick fibrous capsule which contained a few large vessels. The contents consisted of a large amount of thick, green pus. Microscopically, the capsule was composed of a dense, central fibrous structure arranged in parallel rows of collagen. Among these fibers were numerous fibroblasts and scattered polymorphonuclear cells. The under surface of the capsule had a loose fibrous mesh in which there were numerous polymorphonuclear cells. Attached to the outer side of the capsule was an area of gliosis which contained very large, plump astrocytes lying in a very dense glial carpet. In this were scattered ganglion cells. This consisted apparently of adjacent brain tissue. Pathologic Diagnosis: Abscess of capsule.

Comment.—This case has a number of points in common with Case 1: Slow pulse, severe headache, evidences of increased intracranial pressure, confusing localizing signs, the removal of the tumor en masse and lack of all etiologic infective factors.

Case 3.—M. S., male, age 26, clerk, was admitted to the Graduate Hospital January 16, 1937, complaining of a severe left frontal headache and vomiting. The family and past medical history were irrelevant. There was no history at any time of a running ear, sinus infection, persistent cough, head injury, or of any recent infections. On January 11, 1937, without any premonitory symptoms he developed generalized convulsions accompanied by complete loss of consciousness, followed by a period of confusion and, somewhat later, by severe headache over the left frontal region and by vomiting.

When first seen, January 15, 1937, he showed mental dulness, some expressive aphasia, and a right central facial palsy. Pulse, 52; temperature and blood pressure, normal. Upon admission to the hospital the following day, he showed an increase of the above mentioned symptoms and signs, his pulse became as slow as 44, and, in addition, he showed a right sided hemihypalgesia. The fundi and fields of vision showed no definite abnormalities or at most 1D of swelling. Blood count, normal; uranalyses, negative. The spinal tap showed a pressure of 350 Mm. of water and only two lymphocytes in the spinal fluid. Roentgenologic examination of the skull and sinuses was negative. Diagnosis: A space-taking lesion in the left frontoparietal region.

Operation.—January 17, 1937, by Dr. R. A. Groff: A left subtemporal decompression was performed and after opening the dura about one and one-half inches, an abscess ruptured through the cortex. The hole through which the pus was discharging was plugged. A smear showed Streptococci, about seven chains per high power field. The pus was washed from the surface of the brain and dura by alcohol and the entire wound packed with iodoform gauze. Two days later the packing and the plug over the mouth of the ruptured abscess were removed. About one and one-half ounces of pus were discharged, and a rubber tube was introduced into the focus from which the pus was coming. Three weeks later, drainage having ceased, the tube was removed. Several days later a cerebral fungus developed. By the fifth week postoperative, however, it had receded to such an extent that secondary wound closure was possible. The wound was completely healed at the end of the forty-fifth postoperative day. For the first three weeks following operation the patient was given large doses of both prontylin and prontosil.

Subsequent Course.—The patient was seen four months after operation and was free from all symptoms except for a slight hesitancy in speech. The neurologic examination was negative.

Comment.—In this case, despite the absence of any source of infection, the severe, unilateral headache, the slow pulse and the evidence of increased intracranial pressure raised the suspicion of a brain abscess. The localization in this case was clear. The rôle of prontylin and prontosil in the recovery is difficult to evaluate.

Case 4.—W. P., male, age 19, was admitted to the Philadelphia General Hospital April 27, 1937, complaining of severe headache. The family history was irrelevant. At the age of 14 he sustained a fracture of the right frontoparietal region and since then showed behavior disorders with antisocial tendencies. In November, 1936, he received a blow on the head and was momentarily stunned. There was no laceration of the scalp. Two weeks later he began to have pain over the right frontal region and in the right eye. The pain continued until December 22, 1936, when he developed generalized convulsions accompanied by complete loss of consciousness. He was then free from symptoms until January 14, 1937, when he had another convulsion. During the succeeding few weeks he was free from headaches except when he coughed, jumped or ran. However, he became progressively drowsier and on April 27, 1937, developed severe frontal headaches, more marked on right side, and projectile vomiting. There was no history of any upper respiratory infection, furunculosis, or of a chronic cough.

On admission the pulse was 50; temperature, 99° F.; blood pressure, 130/76. He showed some clouding of consciousness and screamed with pain despite opiates. He presented scars over the right frontotemporal region from previous injuries, tenderness on percussion over the same area and dilatation of the veins of the right temporal region. There was slight blurring of the disks but no other positive neurologic abnormalities. Uranalysis, blood and Wassermann were negative, and other routine laboratory studies revealed no significant changes. The spinal fluid pressure was 21 Mm. of mercury and the fluid contained 281 cells, 24 per cent polymorphonuclears and 76 per cent lymphocytes. The roentgenologic finding reported *after* the operation were: No evidence of any old or recent fracture, or of increased intracranial pressure. There was rarefaction in the right frontal bone just to the outer side of the frontal sinus. There was also sclerosis of the right sphenoidal ridge but the frontal sinuses were well outlined and appeared normal.

Operation.—April 30, 1937, by Dr. R. A. Groff: A trephine opening was made over the right frontal lobe just above the fascial attachment of the temporal muscle. An exploratory cannula was introduced into the substance of the right frontal lobe, directed toward the midline and anteriorly. At a depth of about 3 cm. increased resistance was felt. The cannula was advanced farther and entered a cavity from which about 30 cc. of greenish-yellow pus were evacuated. The abscess cavity was then washed out with normal saline solution. The cannula was left *in situ* and dressings applied. Forty-eight hours later the cannula was removed as there had been no drainage through it, and because lavage of the cavity through it did not disclose any residual pus. Culture of the pus revealed the infecting organism to be a pneumococcus Type IV. Three weeks following the operation the patient was symptomatically well and no neurologic signs could be demonstrated.

Comment.—In this case, also, the source of the infection is extremely doubtful. There existed some reason to incriminate the right frontal sinus but a critical study of the sinuses was negative. The history of repeated injuries suggested the possibility of a chronic subdural hematoma. However, the agonizing, unilateral headache, the slow pulse and the pleocytosis justified a preoperative diagnosis of brain abscess.

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Comment.—This case has a number of points in common with Case 1: Slow pulse, severe headache, evidences of increased intracranial pressure, confusing localizing signs, the removal of the tumor en masse and lack of all etiologic infective factors.

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Subsequent Course.—The patient was seen four months after operation and was free from all symptoms except for a slight hesitancy in speech. The neurologic examination was negative.

DISCUSSION.—In three of the four cases no etiologic factor could be determined. In the fourth case the proximity of the abscess to the frontal sinus and repeated injuries may be conceived as possible causative factors. It is reasonable to assume that these cases, in addition to those reported by Evans,[1] must be of metastatic origin. One might infer that the initial infection may have subsided and having been mild, was entirely forgotten. It is also conceivable that the focus of infection was dormant and thus evaded detection. The abscess was *single* in each of the four cases. King,[5] after reviewing the literature, concludes that 50 per cent of metastatic brain abscesses are single lesions.

TABLE II

SYNOPSIS OF THE CLINICAL MANIFESTATIONS IN FOUR CASES OF BRAIN ABSCESS OF UNDETERMINED ETIOLOGY

	Case 1 Right Frontal	Case 2 Left Frontoparietal	Case 3 Left Frontoparietal	Case 4 Right Frontal
Temperature	Normal to 99.3° F.	Normal	Normal	Normal to 99.3° F.
Pulse	64	64	44 to 60	44 to 60
Mental state	Clear	Clear	Clouded	Clouded
Severity of headache	Marked	Marked	Marked	Marked
Unilateral headache	General	More marked on left	Entirely on left	More marked on right
Papilledema	3 to 4 D	4 to 5 D	1 D	Slight blurring
Fields of vision	Slight cut in left temp. field	Slight cut in right temporal field	Normal	Normal
Spinal fluid pressure	350 to 700 Mm. water	No tap	350 Mm. water	21 Mm. Hg.
Cells in spinal fluid	5 to 15	Not examined	2 cells	281
Localizing neurologic signs	Misleading	Indefinite	Definite	Only unilateral headache
X-ray studies	Negative	Indefinite	Negative	Inconclusive
Requiring ventriculography	Yes	Yes	No	No

The duration of symptoms prior to operation in Case 1 was six weeks, in Case 2 three months and three weeks; in Case 4 seven months; and in Case 3 only six days. In Cases 1 and 2 the abscesses were large (measuring 3.5 by 4 by 5 cm. and 6 by 4.5 by 3.5 cm. respectively) and so heavily encapsulated that at the time of operation the lesions were removed en masse as it was

thought that they were solid tumors. In Case 4 the lesion was also encapsulated. In Case 3 there was no encapsulation, and this may be regarded as the only acute abscess in this series.

The analysis of the clinical manifestations (Table II) suggests some diagnostic criteria. In all of the four cases there were evidences of increased intracranial pressure. In three cases there was marked increase in intraspinal pressure while no lumbar puncture was performed in the fourth case. Two of the cases showed marked choking of the disks, while the other two showed only slight blurring of the disk margins. The pulse was slow in all four cases which contrasts markedly with the normal or nearly normal temperatures. These evidences of increased intracranial pressure are more diagnostic of brain tumor than brain abscess. However, the slow pulse rate has long been known to be suggestive of a brain abscess (Gowers,[6] Oppenheim,[7] Bailey[8]). In addition to the slow pulse the excruciating headache, observed in all four cases, was more suggestive of an acute meningitis than of a brain tumor.

The evidences pointing to the existence of infection were meager: The temperature was normal or nearly so in all cases. The leukocyte count was slightly increased in two cases and normal in the other two. In only one instance was there a marked increase of cells in the spinal fluid. The localizing symptoms were no clearer than in the average case of brain tumor and ventriculography was needed in two cases in order to definitely localize the lesion. However, the pain in the head was definitely ipsilateral with the lesion in one case and more marked on the side of the abscess in two other cases.

From personal observation of a considerable number of intracranial space-taking lesions and from a study of these four cases, it appears that the combined occurrence of severe, especially unilateral, headache, a persistent slow pulse, and some evidences of increased intracranial pressure should suggest, even in the absence of any evidence of infection in the nervous system or elsewhere in the body, the existence of a brain abscess. The suspicion of an abscess may then be followed by exploration, and since 50 per cent of these abscesses are solitary, timely and appropriate operative procedures will result in a greater number of recoveries. In the present series the first three cases may be regarded as having made a full recovery, while the fourth is still convalescing.

SUMMARY.—Four cases of solitary cerebral abscesses of undetermined etiology are reported. All the cases recovered following operation. In two cases the abscesses were so heavily encapsulated that they were removed en masse at operation as it was thought that they were solid tumors.

CONCLUSIONS

From the study of these cases, it is submitted that the combined occurrence of severe, especially unilateral headaches, a persistent slow pulse, and evidences of increased intracranial pressure should suggest, even in the absence of evidences of infection in the nervous system or elsewhere in the body,

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DISCUSSION.—In three of the four cases no etiologic factor could be determined. In the fourth case the proximity of the abscess to the frontal sinus and repeated injuries may be conceived as possible causative factors. It is reasonable to assume that these cases, in addition to those reported by Evans,[1] must be of metastatic origin. One might infer that the initial infection may have subsided and having been mild, was entirely forgotten. It is also conceivable that the focus of infection was dormant and thus evaded detection. The abscess was *single* in each of the four cases. King,[5] after reviewing the literature, concludes that 50 per cent of metastatic brain abscesses are single lesions.

TABLE II

SYNOPSIS OF THE CLINICAL MANIFESTATIONS IN FOUR CASES OF BRAIN ABSCESS OF UNDETERMINED ETIOLOGY

	Case 1 Right Frontal	Case 2 Left Frontoparietal	Case 3 Left Frontoparietal	Case 4 Right Frontal
Temperature	Normal to 99.3° F.	Normal	Normal	Normal to 99.3° F.
Pulse	64	64	44 to 60	44 to 60
Mental state	Clear	Clear	Clouded	Clouded
Severity of headache	Marked	Marked	Marked	Marked
Unilateral headache	General	More marked on left	Entirely on left	More marked on right
Papilledema	3 to 4 D	4 to 5 D	1 D	Slight blurring
Fields of vision	Slight cut in left temp. field	Slight cut in right temporal field	Normal	Normal
Spinal fluid pressure	350 to 700 Mm. water	No tap	350 Mm. water	21 Mm. Hg.
Cells in spinal fluid	5 to 15	Not examined	2 cells	281
Localizing neurologic signs	Misleading	Indefinite	Definite	Only unilateral headache
X-ray studies	Negative	Indefinite	Negative	Inconclusive
Requiring ventriculography	Yes	Yes	No	No

The duration of symptoms prior to operation in Case 1 was six weeks, in Case 2 three months and three weeks; in Case 4 seven months; and in Case 3 only six days. In Cases 1 and 2 the abscesses were large (measuring 3.5 by 4 by 5 cm. and 6 by 4.5 by 3.5 cm. respectively) and so heavily encapsulated that at the time of operation the lesions were removed en masse as it was

the existence of a brain abscess. Timely diagnosis is indispensable in the surgical treatment of brain abscess.

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TREATMENT OF HEMORRHAGE AND TRAUMATIC SHOCK BY THE INTRAVENOUS USE OF LYOPHILE SERUM *

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METHODS for the preservation of normal blood serum in desiccated form have been developed by Elser, Thomas, and Steffen,[1] by Reichel and his associates, and by Flosdorf and Mudd.[2] Essentially this procedure is one of rapid freezing at a very low temperature and rapid dehydration from the frozen state under high vacuum. This leaves in dry form all the solid elements of serum. The proteins appear to be unaltered and their antibody properties are preserved in full titre. In this form serum may be preserved for extended periods and is readily dissolved in water to make an isotonic or hypertonic solution. Because of its rapid solubility this product is called "lyophile." For intravenous use serum must be processed twice by this method, with an intermediate filtration to remove fat particles.[3]

In these experiments we have used solutions of lyophile serum intravenously to treat animals which were moribund after experimental shock and hemorrhage. This use has been suggested by Hughes, Mudd, and Strecker,[4] on the basis of their intravenous use of hypertonic lyophile serum in human and animal subjects for lowering cerebrospinal pressure. Hughes has treated a case of shock with serum in conjunction with blood transfusion.

The decrease in circulating blood volume found in secondary shock is regarded as a centrally important occurrence in this syndrome. The mechanism by which this reduced blood volume is achieved is not completely understood, but there exists considerable knowledge as to what are the most important substances lost from the blood stream. Johnson and Blalock,[9] in agreement with earlier workers, have stressed that the plasma was the portion of the blood that was most severely reduced and that in this severe plasma loss it was the escape of the plasma proteins that was of most importance.

Clinical treatment of patients suffering from surgical shock has been directed largely toward the restoration of the blood volume in general and of the plasma proteins in particular. By far the most satisfactory and most logical substance used for this purpose has been whole blood. As whole blood must be typed, is expensive, and is not always readily available, other substances have been substituted with considerably less therapeutic success. The best of these is acacia, used in a solution osmotically similar to plasma, but it occasionally has toxic properties that weigh against its use. The deleterious

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