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## *A Clinical Study*

BY

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## METASTATIC ABSCESES OF THE BRAIN.

### A CLINICAL STUDY.\*

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THE unexpected, sudden appearance of symptoms in suppurative disease of the nervous system, the rapid unfolding of the clinical picture, the puzzling periods of fluctuating signs and, above all, the domination of the more obscure nervous manifestations by the general picture of sepsis, constitute factors that may be bewildering and confusing as well as obstructive to an intelligent comprehension of the problem at hand. In going over a series of cases of intracranial suppuration secondary to sepsis elsewhere in the body, attempts have been made to find, if possible, some common factors. Unfortunately, this is not easy, since each case is almost a law unto itself and markedly individual in its characteristics. There is so complex a panorama of events that infinite variation is possible. Even when traced back from the final stages of the disease, namely, death or cure by operation, the steps in the progress of the infection may be impossible to delineate. Notwithstanding these difficulties and largely because of them, a series of 20 cases was studied in which the suppuration in the brain came from a source elsewhere in the body. They were all proved cases. The diagnosis was proved by necropsy in 18 cases and in 2 by surgical exploration. Because of the marked differences in the cases and in order to get a better comprehension of the whole problem, the cases will be considered under three group headings. It would seem that since the suppurative process in the brain is secondary to a cause elsewhere in the body, emphasis must be laid on the original source of the infection and the cases grouped accordingly. From the pathologic, as well as the prognostic point of view, it has also seemed fitting to consider the cases in the order of the severity of the original infection at the time the patient was observed. In the 3 cases in Group 1, the cerebral abscess was only part of an overwhelming general septic process; in the 14 cases in Group 2, the abscess was secondary to pulmonary or pleural suppuration which may or may not have been in the process of healing, but in any event did not immediately menace life, and in the 3 cases in Group 3, perhaps the most significant clinically, the original infection had run its course, and the process had healed and would have been forgotten but for the signs of cerebral abscess that appeared later and constituted the most striking feature.

\* Read before the Chicago Neurological Society, Chicago, Illinois, April 17, 1930.



**Group 1. Metastatic Abscess of the Brain Secondary to General Sepsis With Endocarditis.** In these cases there is either a rapid, virulent septicemic condition with organisms in the blood stream, endocarditis and multiple embolic abscesses and finally death in a short time from the general infection, or there is a slower process of septic destruction in which complication after complication arises and finally the patient dies from the cerebral abscess, a last and more lethal manifestation of a long-continued process. In either case the cerebral abscess is only one episode in a general septic process. Any one of the other complications would probably have been fatal eventually. These cases, therefore, are of relatively less clinical interest and more of pathologic interest. In cases of pyemia with multiple septic emboli, as a matter of fact, the brain is seldom affected. This will be commented on later in considering cerebral abscess secondary to suppuration of the lung. A case illustrative of those in Group 1 follows:

**Case Abstract.** CASE I (Table I).—A man, aged fifty years, was brought to The Mayo Clinic October 16, 1923, because of convulsions and mental confusion. Five months before, a wound in the right index finger had become infected. The infection spread to the palm and incision and drainage became necessary. Fever of 104° F. occurred, and fourteen days after the onset redness and swelling suddenly appeared in the right calf which did not go on to formation of abscess but subsided spontaneously after about five weeks. The patient was confined to bed because of continued fever and weakness. Frequency and pain on urination were next complained of, and loss of weight and strength continued for two and a half months. At the end of this time and two months before admission he had had a series of general convulsions. Four days later a large perinephric abscess was opened and drained. The temperature diminished and gradually became normal, but convulsions continued and four days before admission he became clouded mentally.

The patient appeared ill and emaciated and was in a state of semistupor. The urine contained pus and blood. There was a discharging sinus in the right flank. The blood count showed a moderate degree of anemia. Pulse, temperature, leukocytes and spinal fluid were nevertheless normal and there was no papilledema. Babinski's sign was positive on the left side. Following spinal puncture the patient improved, became rational and was able to sit up in bed. Another series of convulsions supervened, however, and left hemiplegia rapidly developed with return of the stupor which deepened progressively. In spite of a general enfeebled condition, as a last resort a trephine opening was made over the right frontotemporal area and about 45 cc. of thick, yellow pus was evacuated. The patient again improved for a while but signs of meningitis developed and he died eight days after the operation.

Necropsy showed a group of chronic encapsulated abscesses of the right frontal lobe of the brain with terminal rupture into the right lateral ventricle and suppurative meningitis. A healed area of aortic endocarditis, a healed infected wound of the right hand, and multiple abscesses of the kidneys, prostate gland and perinephric tissues were noted.

This case illustrates one end of the scale of chronicity. The abscesses were in a cluster and one had ruptured into the ventricle



causing the terminal picture. Nevertheless, the abscesses were fairly well encapsulated, apparently chronic, and corresponded to the rate of the progress of events. On the other hand, the course of the patient was steadily downhill, and he was emaciated and exhausted from sepsis when the abscess was operated on. Any other phase of the septic condition might have been fatal. Case III (Table I), it may be noted, was equally as hopeless from the beginning but ran a much more rapid and remorseless course to the end. The 3 cases in this group showed evidence of endocarditis with ample possibilities for widespread infection. In all 3 the abscesses were multiple; in Case I the abscesses were clustered in a group in the anterior end of the right frontal lobe and in Cases II and III they

TABLE I (GROUP 1).—METASTATIC ABSCESS OF THE BRAIN SECONDARY TO GENERAL SEPSIS WITH ENDOCARDITIS.

Case.	Association infections.	Duration of illness.	Clinical course of cerebral complications.	Duration before death.	Necropsy data.
1	Infected right index finger, lymphangitis, perinephric abscess	Five months	Convulsions, increasing in frequency, rapid left hemiplegia; trephined	Two months	Multiple right frontal abscesses, aortic endocarditis; abscesses of kidneys.
2	Diverticula of bladder, cystitis, pyelonephritis	Twelve months	Drowsiness, increasing stupor; death without localizing signs	Eight days	Multiple abscess of brain, mitral endocarditis with embolic abscesses.
3	Acute osteomyelitis, right tibia	Eleven days	High fever and marked toxemia covering all other signs; rigidity of neck toward end	Eleven days	Multiple small abscesses of kidneys and brain, early meningitis.

were small embolic abscesses strewn indiscriminately in both hemispheres and in the cerebellum. Localization was possible in only one of the 3 cases. In the other 2 cases, the patients were so profoundly ill that the cerebral symptoms were identical with those found in any acute toxic process and not necessarily characteristic of local suppuration of the brain. As causes of these pyemic abscesses, Oppenheim mentioned ulcerative endocarditis, phlegmonosis, suppuration of bones or joints, whitlow, carbuncle, septic endometritis, endamebic abscess of the liver and suppurating bronchial glands. Otitis media with or without mastoiditis and septic sinus thrombosis may do the same thing; hence abscess of the brain remote from the side of the affected ear. As is reasonable to assume, any septic process producing pyemia can be a source for multiple cerebral abscess.

As I have mentioned, it has been observed that the brain has a relatively higher resistance to infected emboli from sources other



than the lung. Actually such abscesses are uncommon. Sperling in 76 cases of emboli from the left side of the heart, found that metastatic abscess occurred in the kidneys in 57, in the spleen in 39 and in the brain in 15 only. On the other hand, suppuration of the lung is more often the cause of metastatic abscess of the brain than of abscesses elsewhere. In this series of 20 cases 14 (Group 2), were secondary to pulmonary suppuration.

**Group 2. Metastatic Abscess of the Brain Secondary to Pulmonary and Pleural Suppuration.** In this group the original infective process is serious but not so deadly, and not infrequently it happens that the cerebral abscess constitutes a lethal complication causing death of a patient who might have otherwise recovered. Cases have been reported by Roulland, Seymour, Barling and Hurst and Gardner in which surgical drainage of both brain and lung saved the patient. Too often, however, the patient has had a long siege of disease, is

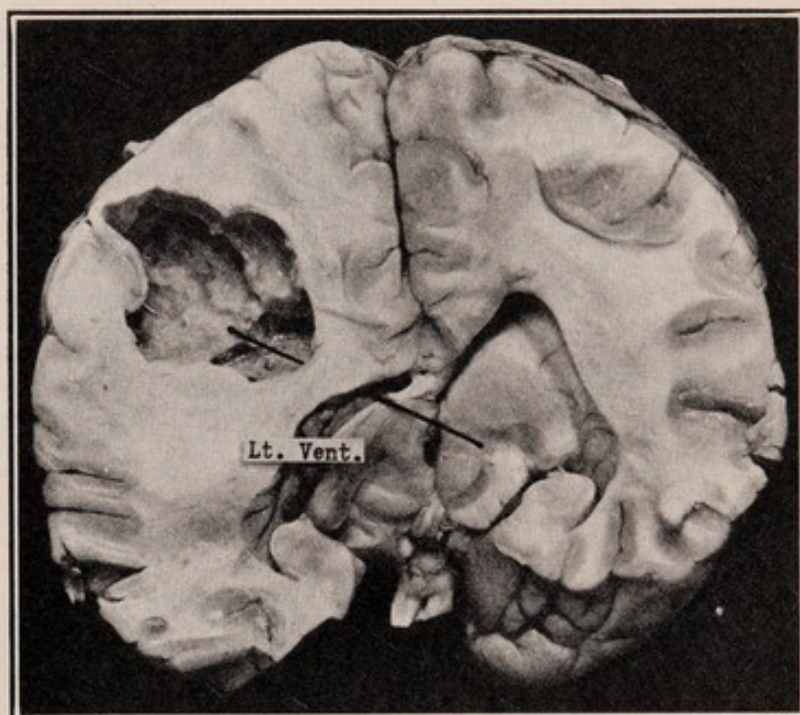


FIG. 1 (Case VIII).—Metastatic abscess of the left parietal lobe of the brain secondary to pleural empyema. The abscess is fairly well encapsulated but is surrounded by a wide zone of softening. Rupture into the left lateral ventricle.

markedly exhausted and his vitality is at a low ebb. An abscess developing in such a case meets little resistance and responds only slightly to surgical drainage. The following case is a good example of this group.

**CASE XIV (Table II).**—A boy, aged eighteen years, came to The Mayo Clinic September 17, 1923, because of cough, weakness and a draining sinus of the left wall of the thorax. Seven years before admission he had accidentally inhaled a brass carpet tack. A sense of strangulation immediately was felt with paroxysmal coughing. The cough continued and the patient lost weight and strength, bringing up foul sputum in increasing



amounts. One year previously the left lung had been explored in a two-stage operation, but the tack was not recovered and the draining sinus persisted.

The patient appeared thin, weak and pale; the odor of his breath was foul. His fingers were clubbed. He had a fever of  $101^{\circ}$  F. A sinus was draining in the left posterior wall of the thorax. Roentgenograms showed bronchiectasis of the left lower lobe and a tack in the left lower part of the bronchus. Bronchoscopy was done and an attempt was made to remove the tack through a bronchoscope but it failed. The lung was explored September 25, 1923, and through a cautery incision the tack was removed. The patient recovered from the immediate effects of the operation but a bronchial fistula persisted with a sinus in the wall of the thorax still draining. He continued to cough up large quantities of sputum. He did not gain strength, and during the following year two other exploratory operations were performed on the thorax and lung in the hope of leading to the closure of the bronchial fistula and sinus. Six days after the second operation, he suddenly felt that his right leg was powerless and then there was a jerking feeling in the right lower wall of the thorax with immediate loss of consciousness and general convulsions. Other attacks followed and he was readmitted to hospital. In a few days weakness of the right arm and leg appeared and he became stuporous and aphasic. His eye grounds were normal. Leukocytosis was present; he ran an intermittent fever, became more stuporous, comatose and died ten days after the first onset of cerebral symptoms.

Necropsy showed a solitary abscess 5 by 5 cm. in the left parietal lobe which had ruptured into the left lateral ventricle. The brain was markedly softened around it. Fig. 1 is illustrative of a similar case.

The relative frequency of metastatic cerebral abscess secondary to suppurative pulmonary or pleural disease has been commented on by all the writers on the subject as well as has the curious predilection of the brain for these abscesses in advance of any other organ in the course of pulmonary disease. Why the brain should be more frequently affected than other organs has been always a puzzling question. The relative infrequency of the formation of abscess in diffuse septic conditions with endocarditis, as mentioned, makes the problem harder to solve. Shorstein suggested that in acute infective diseases the brain has a relatively greater resistance to infective emboli. In chronic suppurative pulmonary disease, on the other hand, the chronicity of the process has allowed the remainder of the body to develop antibodies which the brain fails to do for some unknown reason. Eagleton tried to explain the phenomenon by asserting that the metastatic cerebral abscess from disease of the lungs is primarily of venous and thrombotic origin, as contrasted with abscesses of arterial or embolic origin from endocarditis. Disease of the lungs, he believes, would favor this thrombotic process in the cerebral veins. Gardner suggested that long-continued coughing has an influence. Such straining produces positive intrathoracic pressure, a damming back of venous blood, less filling of auricles, poor cardiac output and transient ischemia of areas in the brain. This tends to lower cerebral resistance to infection. Groth also invoked some mechanical factor in the cir-



culatation induced by disease of the lungs and continued coughing. It may be remembered that a similar phenomenon is seen in carcinomatous metastasis. Carcinoma of the lung frequently metastasizes to the brain and yet the brain is specially resistant to metastasis in general carcinomatosis from other organs. It is manifestly possible that the tissue of the lungs and brain have something in common whereby the brain tissue acts as highly favorable soil for metastasis thrown off from suppurative or carcinomatous processes occurring in the lungs. The problem must be considered as unsolved until more work has been done on the subject.

The cases of cerebral abscess secondary to disease of the lungs and pleura have been arbitrarily divided into various types, those secondary to empyema and those secondary to bronchiectasis and abscess of the lungs. This division is actually rather artificial. The pathologic boundaries of abscess of the lungs, bronchiectasis and empyema are not always definite. In a given case an abscess of the lung may lead to bronchiectatic enlargement of adjacent bronchi; it may rupture into the pleural cavity and form empyema. This may be drained and a combination of abscess of the lungs, bronchiectasis, bronchial fistula, empyema and sinus in the wall of the thorax may be the final clinical picture. Again an empyemic abscess may rupture into a bronchus, and bronchiectasis may form with bronchial fistula. Seldom, if ever, is the lung normal under a chronic empyema cavity, and actually these combinations occurred in many of the cases which form the basis of this report. Accordingly, no attempt has been made to separate the cases due to empyema from those due to bronchiectasis or abscess. Figures, therefore, regarding the frequency of association between the various diseases of the lung and cerebral abscess are subject to criticism. Those of Schorstein are drawn from a relatively large group of 69 cases (19 of his own) of metastatic cerebral abscess associated with suppurative disease of the pleura and lung. In these, bronchiectasis occurred in 38 (55 per cent), empyema in 15 (23 per cent), gangrene of the lung in 6 (9 per cent), and the remaining 10 were evenly divided: tuberculosis, 3; acute pneumonia, 3; abscess of the lung, 2; fetid bronchitis, 1, and emphysema and bronchitis, 1. Schorstein stated that bronchiectasis is the most common pulmonary antecedent of cerebral abscess, and cerebral abscess is the second most common cause of death in bronchiectasis. Cerebral abscess secondary to ulcerative pulmonary tuberculosis is not common; I have, however, seen one case. Another disease of the lungs as a possible cause of cerebral abscess is actinomycosis. There is one of these in the records of The Mayo Clinic. However, it has not seemed advisable to include such granulomatous and mycotic diseases in the present study.

Because of the complexity of the problem, it has been hard to illustrate the common features of the 14 cases of abscess of the



brain secondary to suppuration of the lungs. Signs prominent in one case may be absent in others, and it is difficult to determine which sign is the most significant. Again, infection is a moving process; conditions resembling one another one day may present totally different appearances the next. However, it has been thought best to chart a general panoramic version of each case with the time relations (Table II). Symptoms are mentioned in order of occurrence and a glance may show the general trend of events. The history of many of the cases indicated extreme chronicity of pulmonary symptoms. In the foregoing case (Case XIV) the patient had been

TABLE II (GROUP 2).—METASTATIC ABSCESS OF THE BRAIN SECONDARY TO PULMONARY AND PLEURAL SUPPURATION.

Case.	Clinical course of cerebral complications.	Duration before death.	Necropsy data.
4	Gradual right hemiparesis, stupor, fever, rigidity of neck, purulent spinal fluid	Eight days	Solitary abscess, left frontal lobe, ruptured.
5	Headaches, vomiting, mental confusion, stupor, rigidity of neck, purulent spinal fluid	Three weeks	Solitary abscess, right frontal lobe.
6	Stupor, rigidity of neck	Four days	Solitary abscess, right thalamus.
7	Headache, right temporal region, vomiting, stupor, rigidity of neck, purulent spinal fluid	Eight days	Solitary abscess, right temporal lobe, ruptured.
8	Headaches, weakness right arm, aphasia, fluctuating course, stupor, craniotomy	Nine days	Solitary abscess, left frontoparietal region.
9	Headaches, Jacksonian convulsions, right hand and arm, increasing right hemiplegia and aphasia, craniotomy, stupor	Three weeks	Multiple abscesses of the brain.
10	Headaches, increasing stupor	Six days	Multiple abscesses of brain, ruptured.
11	Delirium, stupor, rigidity of neck, purulent spinal fluid	Few hours	Multiple abscesses, ruptured.
12	Headaches and fever for three days, patient found dead in bed	Three days	Solitary abscess, right parieto-occipital lobe, ruptured.
13	Jacksonian convulsions and gradual right hemiparesis, improvement for few weeks, then suddenly worse	Three months	Solitary abscess, left parietal lobe.
14	Convulsions with right motor aura, rapid development of right hemiplegia with aphasia	Ten days	Solitary abscess, left parietal lobe.
15	Sudden general convulsion, recurred at frequent intervals, gradual left hemiplegia	Two months	Multiple abscesses of brain.
16	Increasing headaches, drowsiness and stupor	Three days	Multiple (more than 50) abscesses of brain.
17	Operation for left mastoiditis, lighting up of old lung infection, sudden stupor with right hemiplegia	Fifteen days	Multiple abscesses of brain.



sick at least seven years. The average total duration of illness in the 14 cases was thirty months. In 12 of the cases one or more operations had been done on the pleura and lung, and in 10 abscess of the brain had developed during convalescence from the last operation. The occurrence of cerebral abscess has been attributed to operative procedures on lungs and ribs, but experience has shown this to be wrong. Schorstein denied any such relationship. He pointed out that in many instances cerebral abscess develops long after, sometimes many months after, the surgical procedures, such as resection of ribs. The abscess frequently occurs in cases in which the opening in the wall of the thorax has never properly closed and a more or less continuous purulent discharge has been kept up. This occurred in 9 of the series of 14 cases. Cerebral abscess may also occur in cases in which no operation has been performed, or in which simple aspiration of an empyemic abscess has been done. Bronchiectasis, whether or not operation is performed, constitutes a continuous menace from the standpoint of this complication.

There was a preponderance of the male sex, in the 14 cases of the series, 13 to 1. Age made little difference; the patients varied from the first to the seventh decade. Eleven patients were in the third to the sixth decade. From the symptomatic standpoint there is little difference between metastatic abscess of the brain and abscess due to other causes. As Schorstein noted, nothing materially new can be drawn from an analysis of symptoms. These abscesses of the brain developed in cases in which the patients were exhausted by long illness, and the abscess, once started, seemed to run a rather acute course. In his 19 cases the average duration of illness from the initial sign of cerebral disease to death was ten days; the illness varied between three and twenty-eight days. In these 14 cases nineteen days was the average; the illness varied from three months to a few hours. Most of the patients lived only a few days after evidence of cerebral involvement appeared. In one case only (Case XIII) was there evidence clinically of a latent period. Table II shows the order of development of symptoms. In 7 of the 14 cases the onset was gradual and the symptoms were of the usual type in cases of abscess of the brain, namely headache, vomiting, local or general convulsions, drowsiness, paralysis and coma. The particular feature of these metastatic abscesses was the rapidity of the course. One patient died a few hours from the onset of symptoms; the abscess had ruptured. One patient was found dead in bed after three days of headache and fever. Three patients had an abrupt and sudden onset with general or Jacksonian convulsions, and one patient had sudden hemiplegia and stupor. One patient suddenly became stuporous; the clinical picture of meningitis appeared, the abscess ruptured and death occurred four days after the onset.

Eight of the patients when first examined had fever and rapid



pulse rate: 3 ran a subnormal temperature and slow pulse and 3 had normal pulse and temperature at the beginning. In 10 of the 13 cases in which a blood count was made, there was leukocytosis. Most of the patients were septic in appearance and suggested some type of spreading infection. It is significant that papilledema was not present in 10 cases in which an ophthalmologic examination had been made. This may suggest that the abscess in each case destroyed tissue as it spread; in many cases wide zones of softening surrounded the abscess. Symptoms were therefore less due to pressure than to a wide encephalitic and disintegrating process. Clinical localization was only possible in 8 cases, but in 4 of these there were multiple abscesses. In 2 cases the abscesses were in the parietal lobe and gave signs suggesting their presence in the frontal lobe. In explanation it was found at necropsy that massive infarcted areas had spread well into the frontal lobe. Spinal puncture was done in 6 cases and purulent fluid was found in five. In all of these cases the abscess had ruptured. A correct diagnosis of abscess of the brain was made in 11 cases; in one case none was recorded and in one case embolic encephalomalacia was given as the cause of death.

In 7 of the cases with cerebral abscess secondary to suppuration of the lungs, the abscess was solitary and in the other 7 more than one abscess was found at necropsy. This agrees with the figures of Gowers, that 46 per cent are solitary, and with those of Eagleton, who, after reviewing the literature of the preceding twenty-five years, thought that 45 per cent of all metastatic abscesses are solitary. Schorstein, however, estimated that in the 51 cases which he reviewed, 32 (62 per cent) of the abscesses were multiple and 19 were single. In my series neither side nor any one lobe of the cerebral hemispheres seemed predominantly implicated. It has been assumed that the left side is the most frequently involved, but any part of the hemispheres may be attacked. The cerebellum was not affected in any of the cases of these abscesses secondary to pulmonary suppuration.

From the standpoint of prognosis and more especially from the possibility that these abscesses may be treated successfully by operative procedures, several factors must be taken into consideration, and first and foremost of these is the physical condition of the patient. Most of these 14 patients were considerably debilitated from long-continued pulmonary or pleural suppuration and multiple operations for relief. These factors elevate the risk of mortality but are not necessarily insuperable obstacles to successful surgical treatment. Enough patients who have been operated on have recovered in spite of the heavy hazard to make an attempt to drain the abscess well justified, provided other factors permit. These are represented in the frequent lack of information leading to accurate clinical localization as well as the possibility of multiple abscesses, of which there is always a 50 per cent chance. Only 7 of the patients in this



group had a single abscess, thereby ruling out the other 7 from all chance of surgical relief. Five of the 7 patients with solitary abscess had grossly and microscopically a fairly well defined capsular wall. With this, one might prognosticate a fair chance for successful drainage. However, only 4 patients of those with solitary abscess manifested signs to indicate where intracranial exploration might be attempted. The other 3 had nothing to indicate which side or lobe of the brain should be explored. Two of the patients manifested clinical signs suggesting the site in the frontal lobe; necropsy revealed an abscess considerably more posterior in the parietal lobe and had exploration been attempted the abscess might have been missed. Again the stage of development of the abscess is important. A few patients were first seen when it was obviously too late to institute treatment. High fever, rapid pulse, leukocytosis, rigidity of the neck and purulent spinal fluid are signs of evil portent, for they indicate rupture of the abscess into the ventricle and an end to all hope of saving the patient. In 4 cases there was good clinical evidence of the site of the abscess, but in 1 case (Case VII) rupture had evidently occurred before the patient was first seen. Three cases, therefore, remain out of the series of 14 of metastatic abscesses secondary to pulmonary disease that were in any way favorable for operation. In one of these (Case VIII) operation was performed and the abscess was drained successfully, but death occurred and necropsy showed a large area of infarction around the abscess. One of the other 2 patients (Case XIII) could possibly have been saved but for the mistaken diagnosis of embolic infarction with encéphalomalacia. In the other case (Case XIV) a solitary abscess was fairly well localized but operation was not performed because of the patient's poor general condition. Rupture of the abscess occurred a few days before death and while the patient was under observation. The whole course of cerebral symptoms in this case only lasted ten days. At necropsy little, if any, encapsulation was evident and the abscess was surrounded by a large area of softening. Altogether these cases do not carry a happy prognosis, but it is possible in a suitable case to save the patient. Favorable signs would be a history of relatively long-standing cerebral trouble, good physical condition and sufficient evidence for clinical localization. Contraindications to operation would be evidence of multiplicity of abscesses or signs of rupture into the ventricles.

**Group 3. Metastatic Abscess of the Brain Secondary to Infection That Had Subsided.** This group differs from Groups 1 and 2 from the standpoint of prognosis and features in the histories. An illustrative case follows:

CASE XIX (Table III).—A man, aged forty-two years, first came to The Mayo Clinic July 20, 1924, because of convulsive seizures. March 3, while lifting a heavy object, he had felt pain in the left lumbar region. This persisted and three weeks later frequency and difficulty in urination



appeared. This increased and examination of the urine, May 13, disclosed a large amount of pus. He had had chills, fever and leukocytosis, and a diagnosis of cystitis and pyelitis was made. Treatment was instituted and the trouble subsided. While convalescing from this about a month before admission, and after the acute phase of the urinary infection, a convulsive attack had come on without warning and while he was sitting quietly reading. Another similar convulsion appeared a week later; this led to his coming to the clinic.

The results of examination of the urine, the eye grounds and spinal fluid, and the leukocyte count were negative. A diagnosis could not be made and the patient was sent home for further observation. He returned August 30, and complained that soon after leaving the clinic severe occipitotemporal headache had appeared and during its maximal severity the pulse was slow.

Examination at this time disclosed slight papilledema of the optic disks, horizontal nystagmus and left homonymous quadrant defect for colors in the visual fields. A diagnosis was made of tumor of the right temporal lobe of the brain and craniotomy was advised.

September 5, a heart-shaped tumor, 5 by 3 cm. was removed. It was attached to the dura and situated in the posterior temporal area of the brain on the right side. There was some brain tissue over the surface of the tumor but no great difficulty was encountered in removing it. Section and microscopic examination showed the tumor to be an abscess with dense thickened walls. The patient recovered from the operation, and is living and performing his usual work six years after operation. The only trouble he has is an occasional convulsive attack about twice a year.

TABLE III (GROUP 3).—METASTATIC ABSCESS OF THE BRAIN: ORIGINAL INFECTION APPARENTLY HEALED; LONG LATENT PERIOD.

Case.	Original infection.	Duration of illness.	Clinical course of cerebral complications.	Duration before death.	Necropsy or operation
18	Osteomyelitis, left elbow, shoulder, right scapula	Four years	Headaches four months, vomiting, prostration, stupor last six days, terminal hemiplegia and coma	Four months	Head only, solitary abscess, right parieto-occipital lobe, ruptured.
19	Cystitis and pyelitis	Six months	Convulsions, headaches, choked disks, field changes		Craniotomy, removal encapsulated abscess <i>in toto</i> , right temporal lobe.
20	Infected teeth (extraction)	Five months	Convulsions, headaches, vomiting, stupor, weakness left side, choked disk		Craniotomy, drainage abscess right frontal lobe.

This case is fairly characteristic of the group and demonstrates the manner in which the cerebral symptoms develop. The symptoms occurred sufficiently long after the disappearance of the original infection to cause doubt as to whether they were associated with the later developments. The course of symptoms was, moreover, slow; in the 3 cases there was an average course of three and a half



months (Table III), a much longer period than in Group 2, in which the average course was nineteen days. Correspondingly at least 2 of the patients in Group 3 presented a picture completely different from those in Groups 1 and 2. After they recovered from the original infection they showed no signs of sepsis. Their color was normal, fever and leukocytosis were absent, and the cells in the spinal fluid did not increase. Moreover, papilledema was present and the general clinical picture led to a mistaken diagnosis of cerebral tumor rather than abscess. The first case in the group (Case XVIII) probably had presented such a picture earlier. Unfortunately, the abscess had ruptured into the ventricle shortly before the patient's admission to the clinic and he died seventeen hours after admission. It is possible that if the patient had been seen earlier a similar mistaken diagnosis might have been suggested, for the lesion from the original infection (osteomyelitis) had been apparently healed for four years, and the patient had been well and working during the interim. It would have required considerable imagination to connect this remote illness with the more recent trouble.

In Case XX simple uncomplicated dental extraction was associated with the serious condition of cerebral abscess. The patient had, however, a congenital lesion of the heart consisting of a patent interventricular septum and this in all probability supplied the missing link between cause and effect. Both Gowers and Schorstein have commented on this association. The former had no hypothesis to offer, the latter, after noting the frequency of this curious association between congenital heart disease and abscess of the brain, believes it may possibly be due to secondary change induced in the lungs by that condition. It is possible also that with a patent interventricular septum the lungs may be relatively short-circuited and a septic embolus may readily pass from the venous circulation to the arterial circulation and thence to the brain. Under normal conditions a septic infarct of the lung would be produced. In all 3 cases there is the mystery of a wandering embolus which reaches the brain and nowhere else, giving signs of mischief long after its source has been healed. A definite latent period was present in Cases XIX and XX and from the first convulsion, occurring as it did while the original infection was disappearing, to the definite progress of cerebral symptoms, there was an appreciable interval. In all 3 cases there was definite encapsulation. The capsule of the abscess in Case XIX was so thick and dense that even at operation it was mistaken for a tumor. Ballance mentioned a case of abscess similarly removed which was as round and hard as a billiard ball. From every standpoint these cases represented a better prognosis and actually the more the condition resembles that of cerebral tumor and the less there is which is suggestive of the formation of abscess the more hope is there for the patient. Generally speaking, the clinical syndrome of the cases in Group 3 suggests a diagnosis of



cerebral tumor since the original infection is much in the background, almost forgotten, and indicates little in the way of etiology until observations at operation or necropsy lead to a review in retrospect of the whole case.

**Summary and Conclusions.** Twenty cases of metastatic abscess of the brain were studied clinically. The diagnosis had been established either by necropsy or surgical exploration.

For convenience the cases were classified in three groups. In Group 1 were 3 cases in which the abscesses were secondary to an overwhelming or progressive general septic process; in Group 2 were 14 cases secondary to pulmonary or pleural suppuration, and in Group 3 were 3 cases secondary to an original septic process that had apparently healed but the signs of cerebral suppuration had appeared later and progressed to menace the life of the patient.

The prognosis depends entirely on the severity and progress of the original infection. In Group 1 the condition was hopeless. In Group 2 it was grave, but in some of the cases might have been modified by operation. In Group 3 surgical treatment at a favorable time was possible and the outcome favorable.

The course of metastatic abscesses of pleural or pulmonary origin was much shorter than that of abscesses due to other causes. This no doubt depended largely on the debility of the patient. The clinical signs and symptoms, however, differed little. The severity of the original infection added a complicating feature, often making the diagnosis extremely difficult.

In 10 of the 20 cases a single abscess was situated in one or the other lobe of the cerebrum. In many of these a certain degree of encapsulation was present but rupture into the ventricle nevertheless occurred readily. In the other 10 cases the brain was the seat of multiple foci of suppuration.

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