Cerebral abscesses in early infancy

Harold J. Hoffman, M.D., F.R.C.S.(C), E. Bruce Hendrick, F.R.C.S.(C), and James L. Hiscox, M.D.
Division of Neurosurgery, The Hospital for Sick Children, Toronto, Canada

Experience with large cerebral abscesses in six newborn or very young infants is the basis for this report and discussion. Hydrocephalus, an afebrile state, and an elevated white blood cell count were characteristic. Diagnosis by aspiration was usually fortuitous in the process of subdural tap or ventriculography. Treatment by multiple aspirations was reasonably successful, but ultimate excision of the shrunken abscess may be wise. In only one case was the source of infection obvious.

Due to the expansile nature of the infantile cranial vault and the poor ability of the infantile brain to ward off infection, the manifestations of a brain abscess in early infancy are different from those in older children and adults. The uniqueness and diagnostic difficulties of these cases have received scant attention over the years. The subject of brain abscesses during neonatal life and early infancy was first discussed by Holt in 1898, and Farley in 1949 reported the first such patient who recovered completely. The incidence of diagnoses and successful treatment remains low, however. There have been 17 cases reported of solitary brain abscesses in one cerebral hemisphere in patients under the age of 3 months,1-4, 5-9 of which only three have survived.

During the past 12 years we have encountered six patients under the age of 3 months with solitary brain abscesses in one cerebral hemisphere. In selecting them for study, we have specifically excluded cases of intracranial suppuration secondary to spontaneous and surgical trauma, and those in association with spinal dysraphism.

Case Reports

Case 1
This boy was admitted to the medical service when 4 days old. He had been febrile for 16 hours before admission and on the evening of admission was noted to have twitching of his face.

Examination. The patient showed signs of meningeal irritation and a reddened inflamed umbilicus. Shortly after admission he had a generalized seizure. The peripheral white blood cell count was 18,600. Lumbar puncture revealed yellow proteinaceous fluid containing numerous mononuclear cells and live paracolobactrum aerogenes. Despite antibiotic therapy he grew steadily worse and died 4 days after admission.

Postmortem Examination. The lungs showed discrete scattered dark blue firm areas. All chambers of the heart were dilated, and a small patent ductus arteriosus was present. The cerebral gyri were somewhat flattened, and no pus was on the surface or at the base of the brain. The right posterior parietal, occipital, and temporal lobes were soft and bluish in color. When the brain was removed this area drained a copious amount
Cerebral abscesses in early infancy

of pus, necrotic brain, and blood. Examination of the fixed brain revealed a large, ragged, hemorrhagic abscess cavity occupying the posterior two-thirds of the right cerebral hemisphere, measuring 6 cm in diameter. Microscopic sections of the lungs revealed that most of the alveoli were packed with red blood cells. There was no evidence of bronchopneumonia. Histological examination of the umbilicus revealed a moderate polymorph infiltration. This was felt to be within normal limits. All of the cerebral blood vessels were patent.

Case 2

This boy was admitted at the age of 6 weeks with a 5-day history of irritability.

Examination. The patient had an asymmetrical head with prominence of the right side, and skull films revealed separated sutures. The EEG was normal. Lumbar puncture revealed 178 lymphocytes and a protein content of 73 mg%. The white blood cell count was 18,100. During an attempted left ventricular tap, an abscess was entered; 120 cc of pus, which subsequently grew pneumococci, were aspirated. Subsequent instillation of contrast material (Fig. 1) located the abscess primarily in the right frontal lobe but showed it extending across the midline to the left. The abscess was treated by multiple aspirations and instillation of penicillin, and the patient was discharged from the hospital 2 months later.

Course. Within a few days of discharge the patient developed acute hydrocephalus and was readmitted and treated with a Holter ventriculoatrial shunt. This shunt subsequently blocked and was revised. His development was slow. He did not begin to walk and speak until he was 4 years old. When he was 6 he was admitted with signs of blockage of the shunt and while being investigated had a sudden episode of respiratory arrest and died.

Postmortem Examination. On sectioning the brain the fixed specimen showed generalized dilatation of the lateral ventricles with massive enlargement of the anterior horn on the right. The latter filled the entire right frontal lobe. Heavy subependymal deposits of thorotrust were present throughout the ventricular system and in the meninges. Section of the right middle lobe of lung showed an aspiration pneumonia, while the picture in the right lower lobe was one of frank lobar pneumonia. Lung culture grew streptococcus viridans and pyogenic staphylococcus.

Case 3

This 6-week-old boy was admitted because of a progressively enlarging head.

Examination. The patient was typically hydrocephalic with an enlarged head, tense fontanel, and split sutures. He was dystrophic and the liver was moderately enlarged. The peripheral white blood cell count was 33,900. During an attempted ventriculogram the needle fortuitously entered a large abscess in the right occipital lobe (Fig. 2). Culture of the pus grew paracolobactrum coliforme. With repeated aspirations the patient improved and was discharged from the hospital 2 months after admission.

Course. The patient was readmitted at the age of 14 months because of progressive hydrocephalus; a Pudenz ventriculoatrial shunt was inserted. His subsequent development was slow and when last seen at age 3, he was blind, grossly retarded, and could not sit up.

Case 4

This baby girl was admitted at the age of 3 months with a 2-week history of focal right-sided seizures.
swollen, softened, and contained pus throughout, from the occipital to the frontal poles. The cavity opened into the cortex in the occipital region and extended forward into mushy necrotic brain tissue. Occipital cortex was largely destroyed. The left cerebral hemisphere was edematous but otherwise normal in appearance. On cut section, there were numerous abscess cavities in the occipital area. These were thick-walled and appeared to have been present for a long time. The lateral ventricles on both sides were hydrocephalic and filled with pus. There was a marked ventriculitis.

Case 5

This boy was admitted at the age of 6 weeks with a 10-day history of vomiting and the sudden onset of stupor.

Examination. The patient was apathetic, had a tense fontanel and split sutures. The temperature was normal, but the white blood cell count was 20,900. Pus was obtained from a subdural tap, and subsequent burr hole exploration of the subdural space led to the discovery of a huge left frontal abscess (Fig. 4). The pus grew proteus mirabilis. He was treated with repeated aspirations and the abscess shrank satisfactorily. Subsequent obstruction of the foramen of Monro required a ventriculoperitoneal shunt.

First Examination. The head was not large, the fontanel was soft, and there were no signs of meningeal irritation. An electroencephalogram showed slow wave activity from the right parietal region. The white blood cell count was 20,500. The spinal fluid showed 18 lymphocytes and a protein concentration of 121 mg%. She was discharged.

Second Examination. The patient was re-admitted 2 months later with a high fever, enlarged head, split sutures, and bulging fontanel. A ventriculogram showed a space-occupying lesion in the right posterior temporal lobe. Burr hole aspiration of the mass revealed an abscess (Fig. 3), which grew paracolobacterium intermedium. This abscess was treated by multiple aspirations, and she was discharged 2 months after this second admission. At 11 months of age she was sitting with support and saying some words.

Third Examination. The patient was readmitted when 15 months old because of irritability and fever. The head was large with the fontanel full. She had a stiff neck. Aspiration of the right cerebral hemisphere yielded 150 cc of pus. She died shortly after admission.

Postmortem Examination. An extensive brain abscess involved the entire right cerebral hemisphere. This had apparently ruptured into the ventricular system as a terminal event. Meninges over the right hemisphere were closely adherent to the cranial vault, and there was a large subdural abscess cavity which had a well-defined fibrous wall. The right cerebral hemisphere was grossly

**Fig. 2.** Case 3. Thorotrast in large right occipital brain abscess.

**Fig. 3.** Case 4. Thorotrast in large right temporo-occipital brain abscess.
Cerebral abscesses in early infancy

Course. The patient has done well, and appears free of any neurological deficit. Examination at 3 years of age (1969) revealed him to be a happy child. He had a Pudenz ventriculoatrial shunt with a pump that filled within 5 to 10 seconds. His chest and cardiovascular system revealed no abnormality.

Case 6

This boy was admitted to another hospital when 6 days old because of seizures. He was afebrile but had a white blood cell count of 19,100. A lumbar puncture revealed elevated protein and 10,000 polymorphonuclear cells per cu mm. The spinal fluid grew Proteus mirabilis. Despite antibiotic treatment he did poorly and was transferred to our medical service 5 weeks later.

Examination. The patient had a tense fontanel, meningealismus, bilateral sixth nerve palsies, and decerebrate posturing. Following a lumbar puncture he rapidly became comatose with fixed dilated pupils and a blood pressure of over 200 mm Hg.

An urgent neurosurgical consultation was obtained, and a needle passed through the split coronal suture fortuitously entered a huge left frontal abscess (Fig. 5) from which 130 cc of thick creamy pus were aspirated. The abscess apparently occupied the entire left frontal lobe. Proteus mirabilis was cultured from the pus. Following multiple taps the abscess became sterile, and the hydrocephalus was treated with a cardiac shunt.

Course. When last seen at age 19 months, his head was normal size, he was talking, could stand alone, and was taking some steps. The patient has remained free of seizures on anticonvulsant medication.

Discussion

Table 1 summarizes the clinical findings and course in the six cases and also illustrates the diagnostic difficulties involved. Two of the patients were treated as cases of purulent meningitis: one died, and the other was only rescued from an episode of transtorial herniation by fortuitous tapping of the abscess. In three other patients the diagnosis was also established by accidental entry of the needle into the abscess during ventricular puncture. In one patient a space-occupying lesion was visualized on the ventriculogram.

The abscesses were enormous in size in all cases and caused significant enlargement of the head in the five patients who reached the neurosurgical service. The widely open sutures in the newborn or young infant allow for progressive enlargement of the head as
the abscess enlarges in the affected hemisphere due to the apparent inability of infantile white matter to ward off infection.

In three patients the abscess ruptured into the ventricle prior to diagnosis, producing a purulent ventriculitis and meningitis. Despite this occurrence, only one of these patients and one other with an unruptured abscess had fever. The remaining four patients were afebrile. However, all six had elevated white blood cell counts.

Only one of the patients showed an obvious septic source for the abscess (inflamed umbilicus) although there is no doubt that the remaining abscesses were of hematogenous origin as well, and may have originated in fetal life, particularly in the two neonatal infants.

A gram-negative bacillus was the responsible agent in five of the patients, demonstrating vividly the poor resistance of the newborn and young infant to this type of infection.

Synthesis of the various immunoglobulins begins approximately at birth and does not reach a normal level in the circulation for several months. The G fraction of these immunoglobulins, however, is passively transferred across the placenta from the mother and thus provides the newborn infant with protection against most viral and gram-positive bacterial infections. The M fraction does not cross the placental barrier and it is this particular immunoglobulin which is bactericidal against the somatic O antigen and gram-negative bacilli. Thus the fetus or newborn infant shows little resistance to infection with pathogenic gram-negative bacilli acquired from the maternal bloodstream or from the nursery.

Our one case of pneumococcal brain abscess occurred in a 6-week-old infant. At this age the passively transferred maternal G globulins are beginning to fall and the infant’s rate of synthesis has not yet succeeded in producing enough of this immunoglobulin to achieve a protective blood level against gram-positive organisms.

During the same period of time that these abscesses were encountered, 93 infants in the same age group were admitted to The Hospital for Sick Children with a purulent meningitis not associated with spinal dysraphism, or secondary to septicemia. Under the age of 1 month, 75% were infected with a gram-negative bacillus whereas this was

### TABLE 1
Summary of clinical findings and course of six patients

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<td>178 lymph</td>
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<td>pneumo.</td>
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<td>—</td>
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<td>r. occip.</td>
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H. J. Hoffman, E. B. Hendrick and J. L. Hiscox

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Cerebral abscesses in early infancy

only true in 20% of those older than 1 month. Thus, M fraction in the newborn makes him susceptible to gram-negative bacillus infections in meninges as well as brain.

These abscesses were too large for excision but did well with multiple aspirations. However, in one of our cases the abscess did recur; this emphasizes that consideration should be given to secondary excision of the abscess once it has shrunk to a reasonable size after multiple aspirations.

Unfortunately, these lesions are not diagnosed before they have reached an enormous size and thus invariably have contaminated the ventricular system which, of course, leads to adhesions and obstruction of the cerebrospinal fluid pathways. All of the surviving patients in our series developed hydrocephalus secondary to adhesions in the ventricular system and required some form of shunting procedure.

Diagnosis can be made if the condition is borne in mind, in an infant with a large head and elevated white count. Treatment is complicated by the hydrocephalus which these patients almost invariably develop, but if the hydrocephalus is adequately treated then these patients can do well.

References


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Address requests for reprints to: Harold J. Hoffman, M.D., Neurological Surgery, Suite 1225, 123 Edward Street, Toronto 101, Ontario, Canada.