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Refer to: West SE, Goodkin R, Kaplan AM: Neonatal Salmonella meningitis complicated by cerebral abscesses. West J Med 127:142-145, Aug 1977

Neonatal Salmonella Meningitis Complicated by Cerebral Abscesses

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THE SALMONELLA GROUP of bacteria is an unusual but well documented cause of meningitis in infancy.¹⁻⁴ Mortality in the neonatal period is high, and the clinical course is frequently prolonged and characterized by relapses during or following appropriate antibiotic therapy. Acute neurologic complications associated with Salmonella meningitis are not uncommon and include ventriculitis,⁵⁻⁸ subdural empyema,^{9,10} hydrocephalus^{6,8,11} and, rarely, cerebral abscesses.^{12,13}

This paper reports a case of Salmonella worthington meningitis with multiple cerebral abscesses in a neonate. The infant nine months after completion of treatment is developing normally without apparent neurologic residua. The importance of prolonged antibiotic therapy, awareness of the neurologic complications especially in cases of relapse or failure of conventional therapy, and the need for early and appropriate surgical management of these complications are stressed.

Report of a Case

A 3-week-old infant was transferred to the St. Joseph's Hospital with a diagnosis of neonatal meningitis.

The infant was born at term to a 21-year-old mother. The labor and delivery were normal, and the immediate postnatal course was reported to be uncomplicated. Apgar scoring was 9-9 at one

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Submitted April 8, 1977.

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ABBREVIATIONS USED IN TEXT

CNS=central nervous system
CSF=cerebrospinal fluid
LP=lumbar puncture
PMN=polymorphonuclear leukocytes

and five minutes respectively, and the birth weight was 3,150 grams.

At approximately 3 weeks of age the infant became irritable with fever, vomiting and increasing lethargy. When seen in an outlying hospital emergency room, the infant was described as ashen and extremely lethargic. There was generalized seizure activity. On lumbar puncture (LP), a cerebrospinal fluid (CSF) pleocytosis with evidence of Gram negative rods was noted, and the patient was transferred for further treatment and evaluation.

General physical examination on admission revealed the patient to be obtunded with intermittent focal seizure activity involving the right forearm and hand. The pulse rate was 204 beats per minute; respirations 50 per minute; temperature 38.4°C (101.1°F). Weight was 3,685 grams. The fontanelle was tense, and the head circumference was 38 cm. Tympanic membranes were normal. The neck was stiff, and a positive Kernig's sign was present. The lungs were clear to auscultation, and cardiovascular examination showed a tachycardia without murmurs. Peripheral pulses were diminished. On neurologic examination, generalized increased tone and intermittent extensor posturing were present. The cranial nerves were normal with full ocular movements. Moro, suck and grasp reflexes were sluggish. The deep tendon reflexes were 3+ bilaterally and symmetrical, and Babinski signs were equivocal.

Initial laboratory studies gave the following values: hemoglobin, 13.7 grams per 100 ml; hematocrit, 43 percent; leukocyte count, 2,500 per cu mm with 23 percent polymorphonuclear leukocytes (PMN), 20 percent band forms, 23 percent metamyelocytes and 26 percent lymphocytes. Platelet count was 149,000 per cu mm. The serum sodium level was 128 mEq per liter; potassium, 5.9 mEq per liter, carbon dioxide

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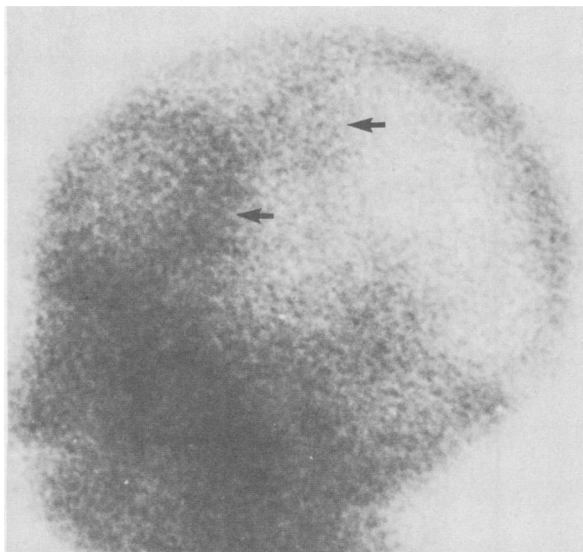


Figure 1.—Isotope brain scan (left lateral view) showing multiple abscess cavities (arrows).

content, 13 mEq per liter; calcium, 9.6 mg per 100 ml; blood urea nitrogen, 11 mg per 100 ml, and glucose, 98 mg per 100 ml. Repeat LP showed 10,000 red blood cells per cu mm and 3,690 leukocytes per cu mm with 85 percent PMN and 15 percent lymphocytes. The CSF protein was 360 mg per 100 ml; CSF glucose, 3 mg per 100 ml, and Gram negative rods were seen on Gram stain. Cultures of blood and CSF grew *Salmonella* worthington. Initial brain scan with technetium Tc 99m diethylenetriaminepentaacetic acid (DPTA) showed an abnormal paramidline accumulation of radionuclide felt to be within the lateral ventricles. There was no evidence of subdural effusion.

Hospital Course

Administration of ampicillin (200 mg per kg of body weight per day) intravenously and gentamicin (7.5 mg per kg of body weight per day) intramuscularly was begun pending culture results. The child also was given decadron (0.5 mg per kg of body weight per day) for three days and phenobarbital (6 mg per kg of body weight per day). When the *Salmonella* organism was identified, administration of chloramphenicol (50 mg per kg of body weight per day) intravenously was begun, and treatment with gentamicin was discontinued. During the first week of therapy, the infant improved clinically, as did results of CSF studies. Cultures were sterile by the fifth hospital day, and after one week of intravenous antibiotic therapy, oral administration of ampicillin and chloramphenicol was started. Three

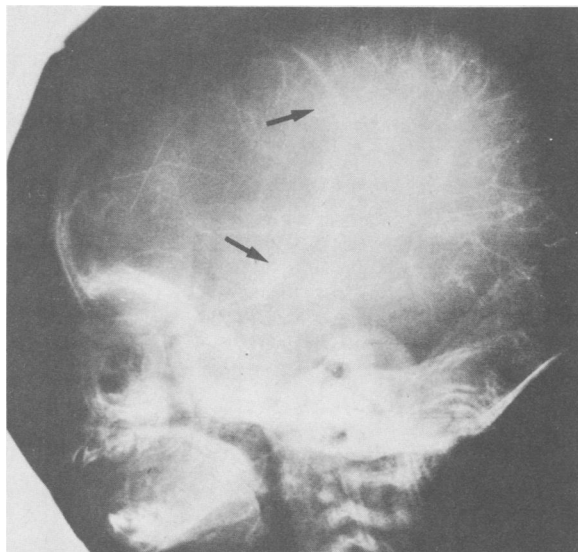


Figure 2.—Left carotid angiogram (lateral view) showing neovascular rim of abscess (arrows).

days later fever and irritability reappeared, and repeat LP showed abnormal CSF chemistries, and *S. worthington* was again cultured. A serum chloramphenicol level at that time was 3 μ gm per ml (normal therapeutic levels—15 to 30 μ gm per ml). Therapy with intravenously given antibiotics was reinstated, but there was little clinical improvement. A repeat brain scan showed increased radionuclide activity bifrontally with a third smaller area of increased uptake more posterior on the left side (Figure 1). Cerebral angiography showed bifrontal avascular masses with a neovascular rim in the left frontal region (Figure 2). Needle aspiration bifrontally through twist drill holes produced purulent fluid, and when air was injected into the abscess cavity there was no evidence of ventricular communication. Continuous catheter drainage of the abscess was started and continued for four days until no further purulent material was noted. Although the chloramphenicol level within the abscess was 18 μ gm per ml with a simultaneous serum level of 23 μ gm per ml, cultures from the abscess grew *S. worthington*. Intravenous administration of antibiotics was maintained for five weeks during which time the patient gradually improved.

Serial head measurements showed an abnormally increasing occipital frontal circumference, and signs of increased intracranial pressure were noted during the sixth hospital week. A ventriculogram confirmed the presence of a communicating hydrocephalus and a ventriculoperitoneal shunt was established. The subsequent course

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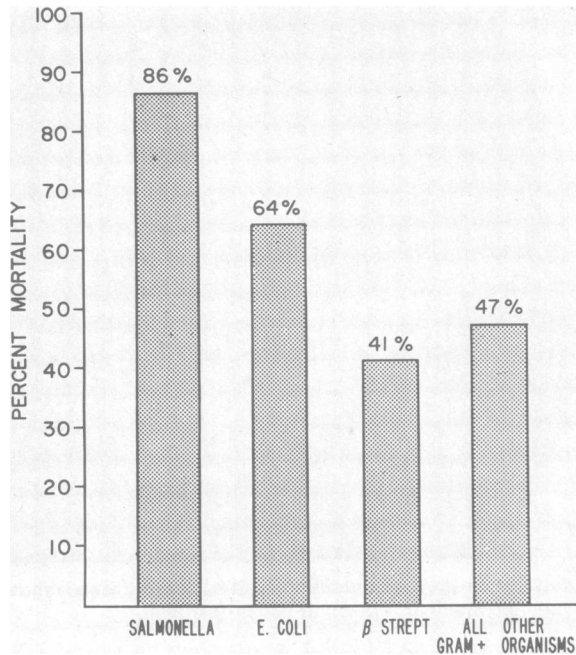


Figure 3.—Mortality ratios of common organisms causing neonatal meningitis.

was one of steady improvement, and the infant was discharged on the 71st hospital day.

At 11 months of age the child walks unassisted, has appropriate social behavior and vocabulary, and has no definite localizing neurological residua. Computerized axial tomography showed satisfactory ventricular decompression, and bifrontal low-density lesions were felt to represent residual cavitation from the previous brain abscesses.

Discussion

Central nervous system (CNS) infection is a rare complication of salmonellosis and was first documented by Ghon in 1907.¹⁴ Most patients with involvement of the nervous system are infants, and Henderson's review of the literature² on *Salmonella* meningitis showed that in 83 percent of cases the patients were less than 2 years of age and in 50 percent they were less than 2 months old. Saphra and associates¹⁵ in a review of 7,779 isolates of *Salmonella* found 77 cases of meningitis, most of which occurred in infants, and Rocha,³ reporting on 1,727 patients less than 18 months of age, noted 22 with meningitis. These studies approximate a 1 percent incidence of CNS infection.

Although there is no characteristic clinical presentation of *Salmonella* meningitis in neonates, the prognosis and course differ significantly from other causes of meningitis in this age group. The

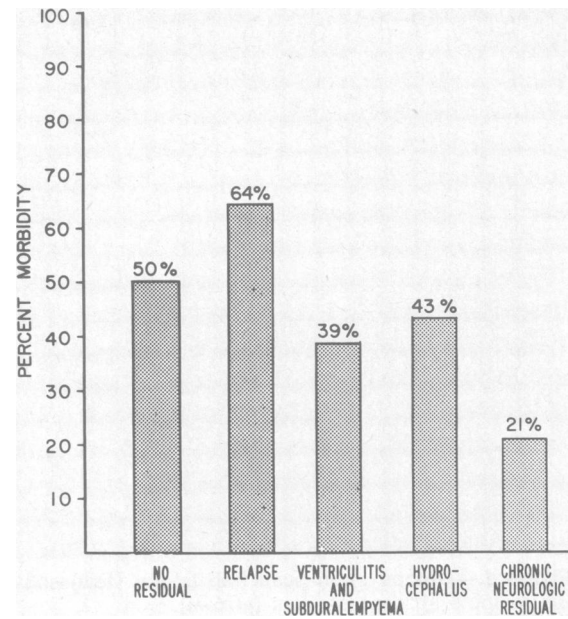


Figure 4.—Morbidity ratios in *Salmonella* meningitis.

mortality ratio of 86 percent is higher than that of other common causes of neonatal meningitis¹⁶⁻²¹ (Figure 3). In a review of 21 cases from the literature^{4-9,22,23} it was found that relapses during or following therapy, ventriculitis, subdural empyema and hydrocephalus were common (Figure 4) and appear to be more frequent than in meningitis due to other organisms. To the authors' knowledge, there have been only two previously reported cases of cerebral abscesses complicating *Salmonella* meningitis, neither of which occurred in a neonate.^{12,13} In the diagnosis of these neurologic complications, brain scan offers a noninvasive means of detecting both subdural effusion and intracerebral abscesses and may even be more sensitive than angiography.²⁴ In addition, computerized tomography is a useful tool in the diagnosis of hydrocephalus. In view of the high incidence of ventriculitis and the fact that the CSF obtained by lumbar puncture may be sterile in the presence of a ventricular abscess, a ventricular tap should be considered in patients in whom there is poor clinical response to therapy.²⁵

Our review of the literature suggests that the medical management of *Salmonella* meningitis should consist of therapy with appropriate parenterally given antibiotics for at least four weeks. Of patients treated for less than four weeks, relapse occurred in six of seven, while there was recurrence in two of six receiving therapy for more than four weeks. The early surgical manage-

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ment of neurologic complications cannot be over-emphasized and is felt to have been a contributory factor to our patient's favorable outcome. In regard to the surgical treatment of intracerebral abscesses, various methods have been utilized and include complete extirpation of the abscess,^{26,27} repeated aspirations²⁸ and continuous catheter drainage.²⁹ The latter was chosen in this case because of the multiple abscesses. Further neurosurgical intervention was not necessary.

Although *Salmonella* is an unusual cause of meningitis in infants, it should be regarded as an extremely virulent and pathogenic organism with high morbidity and mortality. The patient of this case report is unique because of the occurrence of cerebral abscesses complicating *Salmonella* meningitis. Despite adequate drug levels within the serum and abscess cavity, the organism continued to grow, reemphasizing the need for prompt surgical drainage. The pathogenesis of the cerebral abscesses is unclear, but may have arisen by (1) hematogenous septic implantation, (2) contiguous spread from the meninges or (3) extension from ventriculitis. In view of the early brain scan abnormality within the ventricular system, the authors would favor the latter alternative as the source of abscess formation.

Summary

A case of *Salmonella* worthington meningitis in a neonate is reported. Although the disease process was characterized by a relapsing course and complicated by multiple cerebral abscesses, neurologic development nine months after completion of therapy is normal. A review of the literature with emphasis on the neurologic complications, prognosis, and treatment of *Salmonella* meningitis is presented.

REFERENCES

1. Beene ML, Hansen AE, Fulton M: *Salmonella* meningitis—Recovery from meningitis due to *salmonella* sp. (type *montevideo*), with consideration of the problem of *salmonella* meningitis. *Am J Dis Child* 82:567-573, 1951
2. Henderson LL: *Salmonella* meningitis—Report of three cases and review of one hundred and forty four cases from the literature. *Am J Dis Child* 75:351-375, 1948
3. Rocha E: *Salmonellosis* in infants. *J Trop Pediatr* 21:60-63, 1975
4. Smith ES: *Salmonella* meningitis in infancy. *Am J Dis Child* 88:732-739, 1954
5. Bertrand JL, Brunel D, Cret J, et al: Les manifestations extra-digestives des salmonelloses. *Lyon Med* 225 (Suppl):39-47, 1971
6. Froeschle J, Gottfried DF, Grossman M: *Salmonella oranienburg* meningitis in a newborn infant—Treatment with cephalosporin N. *Am J Dis Child* 108:298-301, 1964
7. Luder J, Tomson PRU: *Salmonella* meningitis in the newborn. *Postgrad Med J* 39:100-102, 1963
8. Salmon JH, Berger TS: *Salmonella* meningitis. *Surg Neurol* 3:75-78, 1975
9. Buchanan N, Berger H, Van Hoogstraten RCJ: Subdural empyema caused by *salmonella typhimurium*. *S Afr Med J* 47:1345-1346, 1973
10. Wilner EC, Fenichel GM: Treatment of *salmonella* meningitis. *Clin Proc Child Hosp (Wash)* 25:366, 1969

11. Rabinowitz SG, MacLeod NR: *Salmonella* meningitis—A report of three cases and review of the literature. *Am J Dis Child* 123:259-262, 1972
12. Brzezinski J, Planeta-Malecka I, Zierski J, et al: Ropien mózgu w przebiegu zakażenia pałeczka *salmonella* enteritidis 8-miesięcznego dziecka. *Pediatr Pol* 44:223-226, 1969
13. Paniker CKJ, George K: Otogenic brain abscess caused by *salmonella typhimurium*. *J Indian Med Assoc* 45:451-452, 1965
14. Ghon A: Bericht über den XIV Internationalen Kongress für Hygiene und Demographie. Berlin 4:21-23, 1907
15. Saphra I, Winter JW: Clinical manifestations of salmonellosis in man: An evaluation of 7779 human infections identified at the New York salmonella center. *N Engl J Med* 256:1128-1134, 1957
16. Barclay N: High frequency of *salmonella* species as a cause of neonatal meningitis in Ibadan Nigeria. *Acta Pediatr Scand* 60:540-544, 1971
17. Barton LL, Feigin RD, Lins R: Group B beta hemolytic streptococcal meningitis in infants. *J Pediatr* 82:719-723, 1973
18. Mathies AW Jr, Wehrle PF: Management of bacterial meningitis in children. *Pediatr Clin North Am* 15:185-195, 1968
19. McDonald R: Purulent meningitis in newborn babies: Observations and comments based on a series of 82 patients. *Clin Pediatr* 11:450-454, 1972
20. Swartz MN, Dodge PR: Bacterial meningitis: A review of selected aspects—I. General clinical features, special problems and unusual meningeal reactions mimicking bacterial meningitis. *N Engl J Med* 272:725-731, 1965
21. Yu JS, Grauaug A: Purulent meningitis in the neonatal period. *Arch Dis Child* 38:391-396, 1963
22. Bergstrand CG, Nilsson KO: Neonatal meningitis caused by *salmonella thompson*. *Acta Pediatr Scand* 59:427-431, 1970
23. Teoh-Chan CH: *Salmonella blegdam* meningitis: A study of two cases with necropsy findings. *J Pathol* 88:587-589, 1964
24. Jordan CE, James AE Jr, Hodges FJ III: Comparison of the cerebral angiogram and the brain radionuclide image in brain abscess. *Am J Roentgenol Radium Ther Nucl Med* 104:327-331, 1972
25. Salmon JH: Ventriculitis complicating meningitis. *Am J Dis Child* 124:35-40, 1972
26. Kerr FWL, King RB, Meagher JN: Brain abscess—A study of forty seven consecutive cases. *JAMA* 168:868-872, 1958
27. Samson DS, Clark K: A current review of brain abscess. *Am J Med* 54:201-210, 1973
28. Hoffman HJ, Hendrick EB, Hiscox JL: Cerebral abscesses in early infancy. *J Neurosurg* 33:172-177, 1970
29. Selker RG: Intracranial abscess: Treatment by continuous catheter drainage. *Child's Brain* 1:368-375, 1975

Refer to: Schlepner CJ: Dengue fever in a western United States city. *West J Med* 127:145-149, Aug 1977

Dengue Fever in a Western United States City

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DENGUE FEVER is a clinical entity familiar to few United States physicians except those who were in Southeast Asia during the Vietnam war.¹ The endemicity of dengue fever is worldwide, including West Africa, most Caribbean islands, several countries of Central and South America, Polynesia, Micronesia and tropical Asia, as well as Southeast Asia.² The last of a series of dengue epidemics in the southern United States occurred in 1941;² however, continued infestation of that area with *Aedes aegypti* mosquitoes, the vector of dengue virus,³ makes the southern United

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Submitted December 9, 1976.

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