

penicillin and streptomycin were given, the streptomycin by the intrathecal route, but the patient died three days after admission.

Of the three cases that survived, one received sulphadiazine alone for 23 days, one was given very high doses of penicillin intramuscularly and sulphadiazine orally for two weeks and Ewan's case received sulphadiazine, streptomycin and penicillin, but the dose, route and duration of treatment are not recorded.

P. septica varies in its sensitivity to antibiotics other than penicillin and sensitivity tests are required to control treatment. None of the cases described have received intrathecal penicillin and, although the present case received large doses of penicillin parenterally, the CSF penicillin level may

still have been inadequate. The improvement in the child's condition when chloramphenicol was introduced appears to support the conclusion. In view of Needham's (1948) finding that less than 1 unit of penicillin/ml. is required to inhibit the growth of *P. septica in vitro*, it would be expected that penicillin would be the treatment of choice.

Summary

A case of meningitis in a Mongol child due to *Pasteurella septica* is reported. The difficulties in identifying the causative organism are discussed.

We wish to thank Dr. McMillan, in whose department this work was done, Dr. Gans for permission to quote the clinical details of the case and Dr. J. M. Talbot for confirming the identity of the organism serologically.

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SALMONELLA MENINGITIS IN THE NEWBORN

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MENINGITIS due to organisms of the *Salmonella* family is regarded as a rare event, though there are a number of references in the literature.

It has a particular predilection for the newborn period and a very high mortality at this time. Present methods of treatment are unsatisfactory and it is in order to draw attention to this, and to

increase awareness of this potential hazard in the neonatal period that this case is presented.

Case Report

In November, 1960, there was an extensive outbreak of *Salmonella Typhimurium* Phage la Var. 1, which probably started in a bakery from cream-filled cakes.

Twelve days before baby K.E. was born the maternal grandmother developed abdominal pain and diarrhoea for which she was admitted to a surgical ward. This settled without specific treatment and she was discharged five days later. Nine days before birth the mother had a mild diarrhoea. A specimen was cultured and she was given Guanimycin (streptomycin sulphate 0.25 g., sulphaguanidine 2 g., light kaolin 2 g., 1 oz. q.i.d. for two days). Four days before parturition the report of a growth of *Salmonella typhimurium* was received (sensitive to streptomycin, chloramphenicol, neomycin and framycetin). A second specimen was cultured which was later reported negative and a course of Streptotriad three tablets q.i.d. for six days was started as one negative report was realized to be unreliable. The mother was admitted to a nursing home four days before delivery for observation of postmaturity, and was barrier nursed. Baby K.E. was born by a difficult breech delivery after an unintentional A.R.M., which occurred while the presentation was being confirmed. She cried well (birth weight 7 lb. 3 oz.) and gave no cause for anxiety.

The mother had an urinary infection soon after delivery and was given oxytetracycline 250 mg. q.i.d. for five days.

On the fifth day the baby had loose motions but was not ill and sucked well at the breast (weight 6 lb. 14 oz.). A stool culture was carried out, and on the ninth day it was reported that *S. typhimurium* was grown. She was treated with suspension of Streptotriad orally and improved. By the tenth day the weight was back to 7 lb. 2 oz. and the stools were normal in appearance.

On the seventeenth day she became listless and went off her feeds. The next day the temperature rose and there was slight neck stiffness with a full fontanelle. She was then admitted to hospital.

Cultures of the mother's stools on the 23rd, 25th and 28th days after delivery were negative for *Salmonella*, and culture of her milk on the 22nd day yielded only micrococci.

On admission the weight was 6 lb. 14 oz. and rectal temperature 100°F. She alternated between periods of staring, and irritability when handled. Neck stiffness was present and the fontanelle was bulging. Head circumference was 14½ in. No other abnormal signs were found.

Investigations

A lumbar puncture was performed and the cerebrospinal fluid was found to be turbid and under pressure. It contained numerous clumps of pus cells, so that an accurate cell count was not possible, but was thought to be about 20,000 per cu. mm. The protein content was 1,000 mg./100 ml. and glucose 4 mg./100 ml. Culture yielded a heavy growth of *Salmonella typhimurium*. This was sensitive to a large number of antibiotics and resistant only to the penicillins, erythromycin, vancomycin and novobiocin.

A stool culture at the same time yielded a growth of *S. typhimurium* and *Staph. aureus*. The *Salmonella* in the stool was resistant to more antibiotics, but still sensitive to chloramphenicol, streptomycin, neomycin, framycetin, kanamycin and a combination of novobiocin and tetracycline.

Treatment was begun with chloramphenicol in a dose of 150 mg. intramuscularly for two doses followed by 75 mg. six hourly by mouth. She was also given hydrocortisone 25 mg. b.d. intramuscularly for two days and then prednisolone 5 mg. b.d. by mouth.

Progress

She continued to suck well at the breast for several days, and the temperature fell within four days to 96° to 97°F. The head circumference did not alter and she remained drowsy between feeds.

On the seventh day after admission she vomited profusely, and this was repeated on the eighth day. The fontanelle now began to feel tense again, and she was sucking less well. Two attempts at lumbar puncture were unsuccessful and subdural taps were dry on both sides. The head circumference had not changed but the eyes were beginning to turn down a little.

She was then transferred to the Hospital for Sick Children, Great Ormond Street, London. Antibiotic treatment was continued and then ventricular drainage was instituted. In spite of this she deteriorated and died 11 days after admission there.

Summary of Autopsy Findings (Dr. Martin Bodian)

There was thin pus around the basal cisterns and over the surface of the spinal cord. A complete block was present at the cisterna magna and at the temporal incisura.

The pia-arachnoid was grossly congested and the ventricles were dilated. Purulent material was present in their cavities.

Fatty degeneration was present in the liver.

Discussion

Salmonella meningitis may occur at any age but is particularly common in young infants. The review by Watson (1958) states that 40% of his total of 138 cases occurred in the first month, and 81% in the first year of life. No convincing explanation of this has been given, beyond the well-known susceptibility of the neonate to infection in general, consequent upon poor antibody formation. The possibility of a congenital transplacental infection must also be considered. In our case this is suggested by the presence of *Salmonella* in the mother's stools before delivery, but not afterwards, and by the positive stool culture in the infant within five days of birth.

The diagnosis in the newborn period presents the usual difficulties of the diagnosis of any form of meningitis at this age. It is worth remembering that while diarrhoea due to a *Salmonella* enteritis occurs in some cases, it may be quite mild, as in our case, and easily overlooked, and may indeed be absent in others (Pugh and Vakil, 1952; Smith, 1954).

All reports agree that the *Salmonella* organism causes a severely purulent form of meningitis. This is well brought out here by the presence of pus aggregates in the cerebrospinal fluid, and of thick purulent exudate around the basal cisterns and in the ventricles at autopsy in spite of prolonged treatment. There may in fact be a normal cerebrospinal fluid at lumbar puncture in spite of proven suppurative meningitis at autopsy (Debré and Mozziconacci, 1949).

This pooling of pus explains the persistence of positive cultures from the cerebrospinal fluid after treatment has been in progress for several days with antibiotics supposedly effective by *in vitro* sensitivity tests (Watson, 1958), the frequency of

cerebrospinal block, and the general inadequacy of present methods of treatment with oral broad-spectrum antibiotics, resulting in a mortality of over 90% in the neonatal period. A reduction of this mortality will probably only occur as a result of the earliest institution of adequate treatment. What this treatment should be cannot yet be stated with certainty, though a trial of intrathecal therapy with streptomycin or broad spectrum antibiotics would be justified.

In retrospect, it might have been wise to give

chloramphenicol orally to the baby from birth under the circumstances.

Summary

A case of *Salmonella typhimurium* meningitis is described in an infant in the neonatal period with a fatal outcome. The mother was the probable source of infection and the possibility of transplacental infection is suggested.

The inadequacy of present methods of treatment is mentioned.

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