Meningitis in the newborn – a 14 year review

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SUMMARY A 14 year review of meningitis in babies showed that overall mortality and survival without handicap has not improved. The failure to improve the prognosis of these babies during a period when overall perinatal mortality fell rapidly is because smaller babies are being affected and different organisms are being cultured.

Neonatal meningitis remains a serious problem with a high mortality rate of about 60%.¹ In no other age group is meningitis more common than in the newborn with an incidence of 0.4/1000 live births.²

There are few up to date reviews of neonatal meningitis and so we report our experience over the past 14 years.

Patients and methods

From January 1973 to December 1986, 41 babies with meningitis were treated in the newborn nursery of the Royal Maternity Hospital (RMH), Belfast. These included three babies who were more than 28 days of age and therefore did not meet the strict criteria of 'neonatal meningitis'. Three babies with myelomeningocele were not included. A diagnosis of neonatal meningitis was made if organisms were cultured from the cerebrospinal fluid. In cases in which the cerebrospinal fluid was sterile we used the criteria of Bush who suggested that pleocytosis with a cell count of more than 100/mm³ is diagnostic of meningitis even in the absence of a positive culture.³ If the cerebrospinal fluid was blood stained, a white cell count exceeding normal haemic proportions by

100 cells/mm³ was accepted as diagnostic of meningitis. Analysis of cerebrospinal fluid in our laboratory was done by Gram stains and standard bacteriological methods of culture and inoculation.

Treatment of meningitis was with combinations of antibiotics given intravenously, the most common being an aminoglycoside with benzylpenicillin, chloramphenicol, or a cephalosporin. In addition about half the babies were treated with intrathecal gentamicin. A standard dose of 1 mg intrathecal gentamicin was given daily for one to five days.

A complete neurological examination and Denver screening test was carried out on all surviving infants when they were 2 years of age or older by consultant paediatricians.

Statistical analysis was by Student's *t* test for comparisons of means, and χ^2 or Fisher's exact test for comparisons of proportions; Fisher's exact test was used for small numbers.

Results

INCIDENCE AND RISK FACTORS

Over the 14 year period 44 277 babies were born in the Royal Maternity Hospital, Belfast, of whom 24 developed meningitis, giving an incidence of 0.54/1000 live births. The incidence has fallen progressively from 1979 (1.11/1000 live births) to 0.56 in 1984, with no cases in 1985 or 1986. In addition, 17 babies born at other hospitals also had meningitis treated at RMH. There were 19 boys and 22 girls, mean (SD) birth weight was 1823 (700) g, and mean gestational age was 32.2 (3.7) weeks. Antenatal risk factors were rupture of the membranes for longer than 24 hours (n=8) and maternal infection (n=6).

Table Organisms from cerebrospinal fluid and blood

	1973–1979 (n=19)		1980–1986 (n=22)	
	Cerebrospinal fluid	Blood	Cerebrospinal fluid	Blood
<i>E coli</i>	8	5	7	6
<i>Staphylococcus aureus</i>	3	3	3	3
<i>Streptococcus viridans</i>	1	0	0	0
Group B streptococcus	1	0	1	1
<i>C albicans</i>	0	0	2	0
Others*	0	0	3	3

*Includes one with *Proteus mirabilis*, one with *Serratia marcescens*, and one with *Enterobacter cloacae*.

Five mothers had urinary tract infections and one had appendicitis.

PRESENTATION

Signs and symptoms were vague in most cases, with apnoea being the most common. In only four cases was a full or bulging fontanelle noted, and in no case was fever recorded. In five infants the diagnosis was made at necropsy. Median age at presentation was 9 days (range 1–57).

ANALYSIS OF CEREBROSPINAL FLUID

Twenty nine babies had bacteria cultured from the cerebrospinal fluid, and in 21 organisms were also cultured from the blood. The commonest organism was *Escherichia coli* (table). In 12 babies cerebrospinal fluid was sterile on culture, but they all had a pleocytosis of more than 100/mm³, and in four of the 12 *E coli* was grown from the blood.

OUTCOME

Twenty babies died (49%), and only 13 (32%) survived without handicap. The median age at death was 17 days (range 2–45). Of the eight babies with handicaps, three have hydrocephalus, three spastic tetraplegia, and two monoplegia. Babies weighing less than 2500 g at birth had a significantly higher mortality rate compared with those who had weighed more than 2500 g (figure).

Only two factors were associated with poor outcome: low birth weight ($p<0.05$) and a positive cerebrospinal fluid culture ($p<0.01$). There was no difference in outcome between babies born in the hospital and those transferred from other hospitals.

Figure Outcome of infants and birth weight.

A comparison of risk factors and outcome in babies born up to 1979 and those born after 1979 showed that the latter were significantly lighter and less mature than the former; mean (SD) birth weights were 1584 (563) g and 2101 (753) g, respectively ($p<0.05$). Although the mortality rate was higher in the more recent period ($n=12$, 54%, compared with $n=8$, 42% in the preceding period), survival without handicap was identical during the two periods at 32% (seven and six babies, respectively).

Discussion

Coliforms remain the single commonest organism causing meningitis in the neonatal period.⁴ Outcome remains poor, despite the increased availability of more potent antibiotics and the ability to give them intrathecally.⁵ In recent years, we have noted the appearance of more unusual organisms—for example, *Candida albicans* and *Serratia marcescens*. This probably reflects overall changes in the patient population, with smaller babies being treated for longer periods with intensive care including invasive procedures, parenteral nutrition, and the use of broad spectrum antibiotics.⁶ The outcome for the babies with more unusual organisms was uniformly fatal.

The low incidence of meningitis caused by group B streptococcus may be possibly explained by late presentation to other hospitals.

What is clear from this study is that the rates of mortality and survival without disability are largely unchanged from earlier years, and in this respect one cannot ignore the importance of the treatment of smaller babies and the emergence of different organisms in more recent years. With this change in epidemiology, improved methods of diagnosis and management are needed.

References

- Overall JC. Neonatal bacterial meningitis. *J Pediatr* 1970;76:499–511.
- Goldacre MJ. Acute bacterial meningitis in childhood. *Lancet* 1976;i:28–31.
- Bush RT. Purulent meningitis of the newborn: a survey of 28 cases. *N Z Med J* 1971;73:278–82.
- Mulder CJJ, Zanen HC. A study of 280 cases of neonatal meningitis in The Netherlands. *J Infect* 1984;9:177–84.
- Klein JO. Recent advances in management of bacterial meningitis in neonates. *Infection* 1984;12(suppl 1):544–51.
- Baley JE, Kleigman RM, Fanaroff AA. Disseminated fungal infection in very low birth weight infants. Clinical manifestations and epidemiology. *Pediatrics* 1984;73:144–52.

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