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Purulent meningitis in the newborn infant

By

Éva KAISER, T. FÜLÖP and Klára SZABÓ

Department of Paediatrics, University Medical School, Pécs

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The main clinical features of neonatal purulent meningitis are discussed on the basis of 19 neonatal cases. The liability to infection of preterm and dysmature babies and the role of Gram-negative bacteria in the aetiology of neonatal meningitis is emphasized. Pathological perinatal events should be regarded as predisposing factors. From the point of view of early diagnosis even the most discrete symptoms are of importance. The therapy of choice is early treatment with combinations of broad-spectrum antibiotics in high doses. Repeated electroencephalographic and immunologic examinations provide a useful guideline in treatment and prognosis.

Despite the remarkable progress achieved by antibiotics in the treatment of various bacterial infections, in newborn infants purulent meningitis remained a most dangerous disease with an extremely high mortality rate.

KOPLIK [11] in 1916 reported on 12 young infants with purulent meningitis of whom only one survived, and also this baby developed a hydrocephalus. From the 74 patients treated by HOYNE and BROWN [7] during the period 1912—1940 only 7 recovered completely and also 7 recovered from the 13 patients of DEBRÉ and MOZZICONACCI [4] in 1954. ALISON [1] in 1967 having evaluated his patient material with meningitis from 1945 onwards found that 330 out of 553 died and in one third of the survivors definite signs of neurologic damage could be detected on follow-up examination. Of the 58 premature infants 12 recovered though only half of them completely. In 1968 CHEVRIE et al. [3] observed a 61% mortality in their material of 31 neonates, and 39 babies died and 7 recovered with severe neurological damage out of the 51 patients reported by DELAITRE et al. [5]. OVERALL [16] found the frequency of neonatal meningitis to reach 25 per 54 535 live births; purulent meningitis occurred more often in low birth-weight babies and their mortality rate was 60%. MCCRACKEN [15] and SHINEFIELD concluded that infections with Gram-negative bacteria are usually more serious and found a close correlation between the gravity of the disease, the pathological pregnancy and delivery history of the mother and the low birth weight of the patients.

The purpose of the present paper was to review our cases treated during the past ten years.

TABLE I

Data of the patients investigated

No.	Birth weight, g and percent	Obstetric history	Apgar score	First symptoms	Main clinical symptoms	Associated lesions	Outcome
1.	2580 10	—	9—10	Feeding difficulties. Bulging fontanel, convulsions	Septicaemia. Hyperthermia. Respiratory and circulatory disturbances, abdominal distension	Purulent otitis, purulent pleurisy	Died
2.	1950 25—50	Premature rupture of membranes	9—9	Vomiting, abdominal distension. High pitched cry, muscular rigidity	Hyper- and hypothermia, vomiting, general depression	Enterocolitis. Purulent otitis	Survived
3.	2350 25—50	Toxaemia, twin pregnancy, Caesarean section	9—9	Vomiting, abdominal distension, meconium ileus, acidosis, hepatosplenomegaly	Septicaemia, abdominal distension, hyperthermia, serious metabolic acidosis, respiratory and circulatory disturbances. Muscular hypotonia, hepatosplenomegaly	Omphalitis, meconium ileus, pyelonephritis, skin necrosis	Died
4.	3200 25—50	Threatening abortion. Aspiration of amniotic fluid. Severe asphyxia	2—2	Pleuropneumonia, fever, hypothermia	Hypo- and hyperthermia, cyanosis, jaundice, respiratory distress	Pleuropneumonia	Died
5.	2280 25—50	Anaemia	9—10	Hepatomegaly, jaundice, fever, vomiting, abdominal distension, dehydration	Fever, vomiting, anaemia, hepatomegaly, abdominal distension	Omphalitis	Survived
6.	2550 10	Tumultuous short labor	9—10	Convulsions, fever, cyanosis, abdominal distension, disturbed sensorium	Hypothermia, fever, convulsions, abdominal distension, septicaemia, vomiting, Graefe positivity	Purulent otitis, Bronchopneumonia	Died
7.	2100 10—25	Chronic pyelonephritis	9—10	Hypothermia, loss of appetite, high pitched cry	Depression, muscular hypotonia, high pitched cry, circulatory disturbances, shock, abdominal distension	Hydrocephalus	Survived

8.	3200 50	Toxaemia, infarcted placenta, intrauterine asphyxia. Convulsions, hypoglycaemia. Resuscitation	1—2	High fever, convulsions	Hyperthermia, frequent convulsions, hypothermia	Pneumonia	Died
9.	2620 10	—	8—10	Hyperthermia, convulsions, bulging fontanel, hepatosplenomegaly	Hepatosplenomegaly, hypothermia, convulsions, respiratory and circulatory disturbances	—	Died
10.	2800 10	—	8—10	Hyperthermia, dyspnoea, convulsions, irritability	Convulsions, hypothermia, apnoea	—	Died
11.	1630 10—25	Toxaemia	9—10	Hypothermia, vomiting, repeated convulsions	Abdominal distension, frequent convulsions, hypothermia, haematemesis, septicaemia, hepatosplenomegaly	Enterocolitis	Died
12.	3150 10—25	—	8—10	Purulent skin infection, hyperthermia, irritability	Graefe sign, muscular hypotonia, septicaemia, hepatomegaly	Omphalitis	Survived
13.	2400 10—25	Breech presentation	8—10	Loss of appetite, high pitched cry, hypothermia	Hypo- and hyperthermia	—	Died
14.	4080 50—75	Prolonged labour, rupture of umbilical cord. Asphyxia, resuscitation	1—2	Fever, vomiting, abdominal distension, enterocolitis	Graefe positive, bulging fontanel, dyspnoea, anaemia, septicaemia, hepatomegaly	Omphalitis	Survived
15.	3600 50	Tumultuous short labour. Asphyxia, resuscitation	1—2	Septicaemia, tremor	Septicaemia, tremor. Hepatomegaly	Bronchopneumonia	Survived
16.	2250 10—25	Caesarean section, placental separation. Aspiration of amniotic fluid. Severe asphyxia	1—2	Frequent apnoeic spells, convulsions, hepatosplenomegaly	Convulsion, hepatosplenomegaly, muscular rigidity, strabism	Pneumonia	Survived
17.	2900 10—25	Threatening abortion. premature rupture of membranes	10—10	Dehydration, jaundice, apnoeic spells, convulsions	Generalized convulsions	Purulent otitis	Survived
18.	3200 50	Vaginal discharge, fever, intrauterine asphyxia	10—10	Generalized convulsions, bulging fontanel	Convulsions, muscular rigidity	—	Survived
19.	2650 10—25	—	?	Vomiting, enterocolitis	Hyperthermia, vomiting, convulsions	—	Survived

Patients and Findings

Nineteen newborn infants treated with purulent meningitis in the period 1964—1973 have been studied. Babies with meningitis due to meningomyelocele or hydrocephalus have been excluded from the study. Data of the patients are seen in Table I.

Sex ratio and distribution according to maturity of the patients studied are shown in Table II. The number of males and females was nearly equal.

Table II

Distribution of parients according to maturity and sex

	Male	Female	Total
Mature	6	2	8
Dysmature	2	2	4
Premature	2	5	7
Total	10	9	19

Fig. 1 shows the time of onset of the disease, more precisely the time when the first symptoms were noted. This happened within the first six days in 12 cases, in the second week in 3 cases and in the third week of life in 4 cases.

The most characteristic early symptoms of meningitis are summarized in Fig. 2. A wide fluctuation of body temperature from below 36°C to above 39°C was observed in 11 cases, generalized convulsions as a presenting symptom in 10 babies. Vomiting, abdominal distension and hepatosplenomegaly were also common in the early phase. A bulging fontanel or abnormal irritability occurred in not more than 3 and 2 patients, respectively.

The frequency of symptoms observed during the course of the disease is summarized in Fig. 3. Abnormal body temperature and repeated convulsions were the most common signs during this period, too; hepatosplenomegaly, abdominal distension, respiratory and circulatory disturbances were less frequent.

Bacteria cultured from cerebrospinal fluid obtained by the first lumbar puncture, the sensitivity of microorganisms and the results of cultures taken from various sites (blood, throat, umbilical stump, ear, conjunctiva) are shown in Table III.

Gram-negative bacteria were the most frequent infective agents; they occurred in 14 cases.

Of the 19 patients, 9 died. Data in Table IV show that no significant difference in fatality rate was found between males and females. At the same time the effect of maturity on mortality rate was clear-cut:

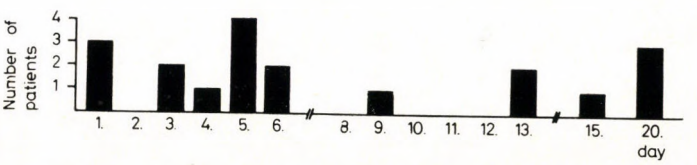

Fig. 1. Age of patients at appearance of first symptoms

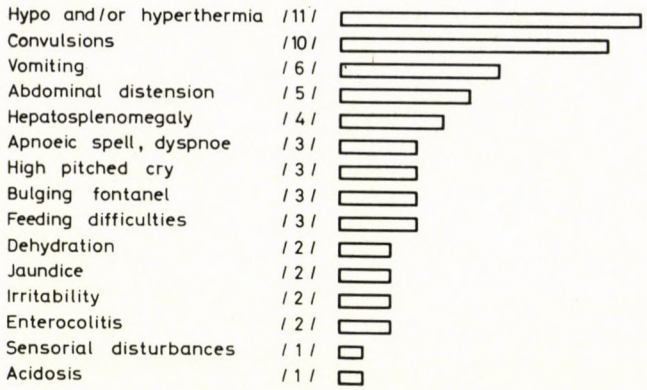

FIG. 2. First symptoms of the disease

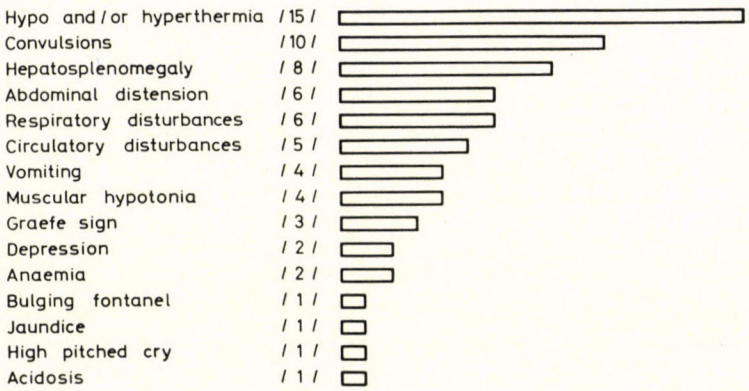

FIG. 3. Main clinical symptoms of neonatal purulent meningitis

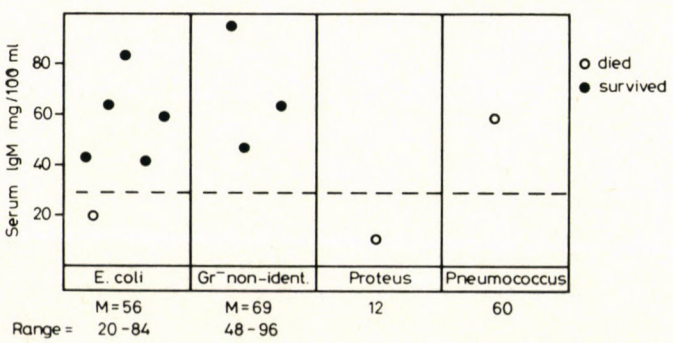

FIG. 4. Relationship between IgM level and bacteria cultured from cerebrospinal fluid

TABLE III

Bacteria, antibiotic sensitivity, leucocyte count, serum immunglobulin levels, outcome of the diseases and necropsy findings

Age (days) at onset of meningitis	Cerebrospinal fluid	Sensitivity to bacteria cultured from CSF	Bacteria cultured from other sites	Leukocyte count and/or smear	Serum immuno-globulins, mg/100 ml	Outcome	Necropsy
6	Turbid 3200/3 *Pneumococcus*	Methicillin Penicillin Polymyxin B	Pleural cavity: *Pneumococcus*	6200 Myeloc. 16, Neut. 54, Mo 2, Ly 28	IgG 760 IgA 0 IgM 60	Died	Septicaemia. Purulent meningitis. Purulent pleurisy
6	Turbid Neutrophils *E. coli*	Chloramphenicol Colimycin Polymyxin B Neomycin	Nose, throat, rectal swab: *Klebsiella* Umbilical: *Staph. alb.*	16800 Myeloc. 6, Neut. 52, Mo. 4, Ly 38	—	Survived	—
1	Slightly turbid 4432/3 Neutrophils *E. coli*	Colimycin Neomycin Streptomycin	Blood culture: *E. coli* Umbilical, urine: *E. coli.* + Sta. *aureus ph.*	2000 Myeloc. 24, Neut. 44, Eo. 4, Ly 26 Mo. 2	—	Died	Twin. Purulent meningitis. Purulent pleurisy. Noma. Septicaemia
6	Xanthochromia 378/3 *Proteus*	Gentamycin Oxacillin Polymyxin B	Pleural cavity: *Proteus* Rectal swab: *E. coli* B_6	11400	IgG 1120 IgA 0 IgM 12	Died	Purulent meningitis, bronchopneumonia. Fatty degeneration of liver and kidneys
4	Slightly turbid 4400/3 Neutrophils *E. coli*	Gentamycin Microcillin Oxacillin	Blood culture: *Ps. pyocyanea*	22200 Myeloc. 18 Neut. 56 Ly 26	IgG 840 IgA 0 IgM 48	Survived	—
4	Turbid *E. coli*	Gentamycin Oxacillin Polymyxin B	Blood culture: *E. coli*	3600	IgG 620 IgA 0 IgM 20	Died	Septicaemia. Purulent otitis Purulent meningitis
6	Slightly turbid 2040/3 *E. coli*	Chloramphenicol Gentamycin Kanamycin	—	10800 Myeloc. 28 Neut. 44 Mo. 2 Ly 26	IgG 920 IgA 0 IgM 80	Survived	—

16	Turbid 4800/3 Lymphocytes *Ps. pyocyanea*	Colimycin Gentamycin Methicillin Neomycin Polymyxin B	Bronchi: *Ps. pyocyanea*	16400 Myeloc. 6 Neut. 56 * Ly 38	—	Died	Purulent meningitis. Pneumonia, septicaemia. Fatty degeneration of liver and kidneys
21	Turbid 4530/3 Neutrophils *Pneumococcus*	Penicillin Polymyxin B	—	4700 Myeloc. 38 Neut. 10 Mo. 4 Ly 42	—	Died	Purulent meningitis. Purulent otitis. Degenerated myocardium
21	Turbid 400/3 *E. coli*	Chloramphenicol Streptomycin	—	12000 Neut. 68 Ly 32	—	Died	Purulent meningitis
1	Clear No pathogens isolated	—	—	10200 Neut. 40 Ly 60	—	Died	Purulent meningitis, cerebral haemorrhage. Septicaemia. Enterocolitis
14	Turbid 1020/3 Neutrophils Gram-neg. Non-ident.	Gentamycin Kanamycin	Throat swab: *St. au. haem.*	12800 Myeloc. 2 Neut. 32 Ly 66	—	Survived	—
6	Turbid 1500/3 Neutrophils *E. coli*	Chloramphanicol Aureomycin Neomycin Streptomycin Tetracyclin	—	4200 Neut. 50 Ly 50	—	Died	Purulent meningitis. Purulent otitis. Mastoiditis. Deg. Parench. of liver and kidney
1	Turbid Gram-neg. non-ident.	Gentamycin Kanamycin	Umbilical: *E. coli* + *Enterococcus* Rectal swab: *E. coli* K 86. Skin: *St. au. haem.* Bronchus: *Klebsiella*	—	IgG 600 IgA 8 IgM 96	Survived	—

Table III (cont.) Text see page 6

Age (days) at onset of meningitis	Cerebrospinal fluid	Sensitivity to bacteria cultured from CSF	Bacteria cultured from other sites	Leucocyte count and/or smear	Serum immunoglobulins, mg/100 ml	Outcome	Necropsy
10	Turbid 1728/3 Neutrophils *E. coli*	Ampicillin Gentamycin Kanamycin Methicillin Polymyxin B	Blood culture: *E. coli*	5000 Neut. 36 Ly 64	IgG 1200 IgA 0 IgM 60	Survived	—
14	Slightly turbid 180/3 Gram-neg. Non-ident.	Cefaloridine Chloramphenicol Gentamycin Kanamycin Methicillin Furadantin	Blood culture: *E. coli* Umbilical: Gram-neg. non-ident. Conjunct.: *St. au. haem.*	5400 Myeloc. 2 Neut. 20 Ly 60 Eo. 2 Mo. 16	IgG 840 720 IgA 0 0 IgM 48 64	Survived	—
5	Turbid *E. coli*	Gentamycin Kanamycin Chloramphenicol Polymyxin B Ampicillin	Urine: *E. coli* + *Klebsiella* External auditory canal: *St. au. haem.*	8000	IgG 1220 920 IgA 0 80 IgM 44 84	Survived	—
28	Slightly turbid No pathogens isolated	—	Rectal swab: *E. coli* B_4	7000 Myeloc. 2 Neut. 54 Ly 44	—	Survived	—
4	Turbid Neutrophils *Streptococcus*	Penicillin Erythromycin Polymyxin B Methicillin	Conjunct: *St. au. haem.* Nose, throat: *St. au. haem.* + *E. coli* Gastric: *St. au. haem.*	4200 Myeloc. 16 Neut. 16 Eo. 2 Ly 62	—	Survived	—

TABLE IV

Maturity, sex ratio and mortality rate

	Number of cases	Male	Female	Mortality +/n
Mature	8	2	0	2/ 8
Dysmature	4	2	2	4/ 4
Premature	7	1	2	3/ 7
Total	19	5	4	9/19

one fourth of mature and nearly half of the preterm babies succumbed, and none of the dysmature infants survived. In other words, 7 out of the infants who died were preterm or dysmature.

TABLE V

Bacteria cultured from cerebrospinal fluid and mortality rate

Infecting agent	Number of cases	Mortality rate +/n
Gram-negative		
E. coli	9	4/9
Ps. pyoceyana	1	1/1
Proteus	1	1/1
Uncertain	3	0/3
Coccogenic		
Pneumococcus	2	2/2
Streptococcus B	1	0/1
Sterile	2	1/2
Total	19	9/19

The mortality of patients in relation to the causative microorganism cultured from the CSF is shown in Table V. In Table VI the survival

TABLE VI

Mean survival time of the 9 dead babies

<24 hrs	1—3 days	4—6 days	> 6 days
3	3	2	1

time of the dead patients is presented; 6 died during the first three days of treatment.

Estimation of serum IgG, IgA and IgM concentration was performed by the gel-diffusion method of MANCINI [14]. Blood samples were taken from the cephalic vein and antisera of Human, Budapest, were used for the procedure.

Figure 4 shows the IgM level during the first three days of meningitis in relation to bacteria cultured from the CSF. The dotted line shows the normal range of human neonates. It can be seen that the IgM level rose definitely in all but two patiens who died within the first 24 hours after admission. The baby with pneumococcal meningitis survived for six days. In spite of the small number of cases we have concluded that, regardless of its somatic maturity or the type of the infecting agent, the newborn infant is able to produce antibodies of the macroglobulin type in response to an antigenic stimulus, provided there is time for their development.

As to the IgG level, this was low in the preterm and dysmature infants, but no hypogammaglobulinaemia occurred. IgA could not be detected in measurable amounts in either of the patients.

Electroencephalographic studies were performed in the testing state by bipolar electrodes. The EEG pattern was judged according to DREYFUS-BRISAC and BLANC [6], LAGET and SALBREUX [12] and our own experience. In 7 cases a normal activity, while in 10 a diffuse and slow (1—1.5 c/sec) frequency, with 200—300 mV amplitude and slight assymmetry was recorded. In 4 cases a continuous focal activity of 2—2.5 c/sec frequency with a physiological background activity was found.

In order to illustrate the importance of repeated EEG control, the data of patient K. are presented. He had become ill on the sixth postnatal day and in view of hypothermia and flaccid muscles the possibility of central nervous disease arose. A lumbar tap revealed in the CSF 2040/3 mm^3 polymorphonuclears and *E. coli* was cultured. The first EEG showed a paradoxically primitive topographic distribution with theta activity of 5—6 c/sec frequency and 20—30 mV amplitude over the posterior cortical areas. Over the right temporo-parietal region a few short 2—2.5 c/sec delta series were found. On the record taken 10 days later a background theta activity of 5—6 c/sec was the predominating finding, with continuous delta series of 1—2 c/sec frequency and 120—180 mV amplitude, with definite right side focality and a few spikes. Convulsions of epileptic character were not observed. On the grounds of the normal CSF findings and the good clinical condition, treatment was then discontinued. After a 7-day symptomless interval a full-blown relapse occurred and reinstitution of treatment for 20 more days was required. On discharge the patient was completely well, but on the EEG some focal abnormalities could still be seen with occasional (but no more continuous) delta activity and spike potentials.

DISCUSSION

Bacterial meningitis in the newborn infant is a serious disease with high lethality and high frequency of residual damage in the survivors. Early diagnosis and prompt adequate treatment are the only possibilities for improving the prognosis.

The grave prognosis is due to three facts:

1. neonatal purulent meningitis occurs predominantly in preterm babies;

2. the infecting bacteria are usually Gram negative;

3. due to the great variability of initial symptoms the disease is often diagnosed late.

The initial symptoms were noted within the first ten postnatal days in most of the infants included in this study. In the history, maternal and foetal-neonatal pathological events were reported in half and a quarter of the cases, respectively. The most common were maternal toxaemia and premature rupture of the membranes, conditions wellknown for predisposing to infection [9, 10].

The significance of infections acquired via the placenta and those ascending through the birth canal cannot be questioned. To these well-known sources infection, the technique of intensive neonatal care (resuscitation, umbilical catheterization, parenteral alimentation, etc.) has added a score of new ones.

It has been established that the normal newborn infant is able to produce antibodies in response to

various antigenic stimuli, but the immunologic competence of the human neonate exposed to stress effects is far from being clear. It is known to be influenced by cellular and local tissue immunity, furthermore by antibacterial factors of the serum. Still, it is not possible to foresee if septicaemia in the newborn will or will not be associated with meningitis, and meningitis may develop even during intensive and proper treatment [15].

Our observations suggest that preterm and dysmature infants are especially liable to infections and so also to purulent meningitis. In two thirds of our cases the meningitis had manifested itself during the first week of life. Its early diagnosis is of great prognostic importance and every effort should be made to recognize the disease as early as possible. Since at first only discrete signs point to the infection, "minimal symptoms" have to be evaluated and the possibility of meningitis should always be borne in mind. In our experience, wide and rapid fluctuations in body temperature are a a fairly common indicator of meningitis. Generalized convulsions are a serious warning sign. The old thesis of paediatrics is still valid: if the newborn infant behaves strangely, one should think of meningitis and not hesitate to perform a lumbar puncture.

When prescribing the treatment, it should be taken into consideration that the infecting agent is usually a Gram-negative microorganism. Precise culturing of the CSF and reliable sensitivity tests are of great importance, but even before receiving their result, treatment should be instituted with a combination of at least two antibiotics of broad spectrum. In suspicious cases, gentamycin should be given without delay. Intrathecal administration of an effective antibiotic is also of much benefit.

Among our patients who died with purulent meningitis, three fourths were preterm and/or dysmature babies. Besides, all dysmature infants with meningitis died, while of the prematures only half were lost. The disease usually takes a hyperacute course and the first three days are the most critical.

The IgM level was very low in those infants who died within few days; much higher levels were detected in those who survived. The IgG level showed no remarkable changes in comparison with normal values and in the IgA level no rise was detected either. Thus, newborn as well as preterm and dysmature infants respond to antigenic stimuli with the production of IgM antibodies, provided there is sufficient time for their development. Since the IgG level was normal throughout, gammaglobulin administration is superfluous in the case of meningitis.

The EEG is a useful tool in the diagnosis of neonatal meningitis. In newborn infants, a paradoxical reactivity may occur [12]; during the first postnatal days we observed cases with nearly physiological activity

which soon became pathological. The EEG seems to offer a reliable help in evaluating active inflammations. As long as continuous delta activities are recorded, antibiotic therapy should be continued, regardless of the clinically good condition of the patient. The possibility of residual neurologic damage emerges if focal signs can be detected on the EEG. These infants require repeated EEG control and constant medical care.

References

1. Alison, F.: L'expression clinique de l'infection chez le nouveau-né. Infections bactériennes. XXI[e] Congrès de l'Association des pédiatres de langue française. Paris, 1967.
2. Bodrogi, G., Lukács, V. F.: Über die bakterielle Meningitis bei Neugeborenen. Acta paediat. Acad. Sci. hung. **13,** 111 (1972).
3. Chevrie, J. J., Aicardi, J., Dhaussy, C., Thieffry, St.: Les méningites purulentes du nouveau-né. Arch. Péd. **25,** 849 (1968).
4. Debré, R., Mozziconacci, P., Berkman, M.: Les méningites purulentes du nouveau-né. Étude clinique et pathogénique. Sém. Hôp. Paris, **30,** 4479 (1954).
5. Delaitre, R., Testard, R., Varlet, Ph., Collin, G., Achard, J.: Pronostic actuel des méningites purulentes du nouveau-né. Arch. franç. Pédiat. **26,** 559 (1969).
6. Dreyfus-Brisac, C., Blanc, C.: Électro-encéphalogramme et maturation cérébrale. Encéphale **45,** 205 (1956).
7. Hoyne, A., Brown, R. H.: Staphylococcal meningitis. Arch. Pediat. **65,** 175 (1948).
8. Járai, I., Mestyán, Gy., Schultz, K., Horváth, M., Lázár, A: Életveszélyes állapotok az újszülöttkorban II. A dysmaturitás mint veszélyeztetettségi tényező a pécsi Gyermekklinika koraszülött és pathológiás érett-újszülött halálozásának tükrében. Orv. Hetil. **113,** 2826 (1972).
9. Kaiser, É., Bakó, M., Storcz, J., Ötvös, I., Rubecz, I., Mestyán, J.: Clinical correlations with immunoglobulin levels in newborns in a referral neonatal unit I. History of pregnancy and delivery, microbial agents, clinical types of infection, presenting symptoms and serum IgM globulin. Acta paediat. Acad. Sci. hung. **14,** 179 (1973).
10. Kaiser, É., Bakó, M., Storcz, J., Ötvös, I., Rubecz, I., Mestyán, J.: Clinical correlations with immunoglobulin levels in newborns in a referral neonatal unit. II. Neonatal responses of immunoglobulins in full-term, preterm and dysmature infants admitted with suspected or proved infections. Acta paediat. Acad. Sci. hung. **14,** 191 (1973).
11. Koplik, H.: Meningitis in the newborn and infants under 3 months. Arch. Pediat. **33,** 481 (1916).
12. Laget, P., Salbreux, R.: Électro-encéphalographie infantile. Masson et Cie, Paris 1967.
13. Liszkai, L.: Az újszülöttkori coli meningitisekről. Gyermekgyógyászat **12,** 153 (1961).
14. Mancini, G., Carbonara, A.O., Heremans, J. F.: Immunochemical quantitation of antigen by single radial immunodiffusion. Immunochemistry **2,** 235 (1965).
15. McCracken, G. H., Shinefield, H. R.: Changes in the pattern of neonatal septicemia and meningitis. Amer. J. Dis. Child. **112,** 33 (1966).
16. Overall, J. C.: Neonatal bacterial meningitis. J. Pediat. **76,** 499 (1970).

Dr. Éva Kaiser
Gyermekklinika
7623 Pécs, Hungary