THE PROGNOSIS OF PNEUMONIA IN INFANCY AND CHILDHOOD

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The use of the sulphonamides and penicillin in the therapy of pneumonia and bronchopneumonia in children has considerably altered the prognosis in these diseases. Although there are reports on the results of treatment with various sulphonamides, there are only a few published studies on the response to treatment with penicillin alone or with penicillin and sulphonamides combined. It was felt, therefore, that a survey of the results of treatment of pneumonia during the past three years at two children's hospitals might be of value in assessing the therapeutic efficiency of methods currently employed.

The records of all pneumonia cases admitted to the Royal Manchester Children's Hospital and to the Duchess of York Babies Hospital during 1946, 1947, and 1948 have been examined. The clinical

diagnosis in all cases included in this study was confirmed radiologically and, in the event of death, by necropsy. Two hundred and fourteen cases were thus surveyed.

The overall mortality in this series (Tables 1 and 2) with all forms of treatment was 17% (33 of 194 cases). This rather high mortality is accounted for by the large number of infants under six months of age. Figures given by Scandinavian authors varied from 22% (Friedlander, 1931) to 14% (Lichtenstein, 1939; Vilen, 1942), while in this country mortality figures of 17% in 1937 (Gaisford, 1940) and 18% in 1939 (King Lewis, 1944) were recorded. More recently a fatality rate of 28% from bronchitis and pneumonia in infants under one year of age for the period 1946-1948 was given by Smellie (1949).

In the present series, excluding the cases under

TABLE 1
ANALYSIS OF 194 CASES, SHOWING AGE DISTRIBUTION, TREATMENT, AND RESULT

Treatment	Age					Result	
	0-6 (months)	6-12 (months)	1-2 (years)	2-5 (years)	5-10 (years)	Recovery	Death
Sulphonamide ..	18	9	17	4	7	48	7
Penicillin ..	22	12	6	13	10	51	12
Combined therapy ..	36	20	10	6	4	62	14
Total	76	41	33	23	21	161	33

TABLE 2
ANALYSIS OF 33 DEATHS ACCORDING TO AGE AND TREATMENT

Treatment	Age					Total
	0-6 (months)	6-12 (months)	1-2 (years)	2-5 (years)	5-10 (years)	
Sulphonamide ..	5	1	0	1	0	7
Penicillin ..	12	0	0	0	0	12
Combined therapy ..	11	3	0	0	0	14
Total	28	4	0	1	0	33

six months of age, there were only five deaths in 118 cases (4%). The mortality rate, therefore, over six months of age, whatever method of treatment be used, is low and a favourable prognosis may be expected.

In striking contrast, the mortality under six months of age is still very high. Reviewing all forms of treatment it was found that there were 28 deaths among 76 infants, a mortality rate of 36%.

Considering the sulphonamide-treated group under six months of age, five deaths (27%) occurred among 18 cases. King Lewis (1944) in a comparable group found a mortality of 11.1% (three deaths out of 27 cases). Using sulphapyridine Greengard, Raycraft, and Motel (1941) reported a mortality of 12% in infants under three months and 16% in those from three to six months of age. Gaisford (1940) reviewing 178 cases of bronchopneumonia in children of all ages treated with sulphapyridine recorded an overall mortality rate of 8.4%. Analysis of these figures (Gaisford, 1939), however, shows that of 11 cases under six months of age five died (45%) and that there were five deaths among 40 cases in the six to 12 months age group (12.5%). Between the ages of one and two years there were four deaths among 50 cases (8%) but there were no fatalities in the older age groups.

A combination of sulphonamides and penicillin does not appear to be any more effective than either drug used separately. Among 36 cases treated with such a combination there were 11 deaths (30%). Thus, no benefit can be claimed for the added penicillin.

Furthermore, considering the mortality figures at all ages, the highest percentage of deaths occurs in the under six months age group, while between six months and one year there is already a considerable diminution in these figures. Over one year of age there was only one death out of 77 cases (1.3%). Reviewing the age distribution of deaths from pneumonia in the whole of Manchester over a similar period, it can be seen (Table 3) that the greatest number of deaths again occurs in the under

TABLE 3
DEATHS FROM PNEUMONIA IN MANCHESTER

Year	Age				
	0-6 (months)	6-12 (months)	1-2 (years)	2-5 (years)	5-10 (years)
1946	91	26	15	2	1
1947	121	32	13	5	0
1948	85	22	8	6	0
Total	297	80	36	13	1

six months age group, while in the second half of the first year there is a marked decrease in the death rate. During the remainder of childhood the mortality figures are very low. The hospital figures therefore reflect the general mortality trend for the whole area of Manchester, although older children and milder cases in infancy are usually treated in their homes, and only the more severe cases are now sent to hospital.

It is therefore obvious that any attempts to reduce the mortality rate from pneumonia must be directed towards improved treatment during the first six months of life. As new and more powerful antibiotics, with varying ranges of specific action, come into use, a closer study of the aetiological organism responsible for the pulmonary infection may help to improve the response to treatment, as it is possible that sulphonamide- and penicillin-insensitive organisms may account for a proportion of the pneumonias occurring in this age group. Although it is extremely difficult to obtain sputum for bacterial examination from infants, culture of a post-nasal swab, particularly one taken after a bout of coughing, may reveal a predominating organism which can with a fair degree of probability be regarded as the chief pathogen, and so indicate the appropriate specific treatment (Alexander, Craig, Shirley, and Ellis, 1941; Olshaker, Ross, Recinos, and Twible, 1949). A big disadvantage, however, is that some time must elapse before this specific therapy can be started.

TABLE 4
ANALYSIS OF 20 DEATHS WITHIN 24 HOURS OF ADMISSION

Age					Total
0-6 (months)	6-12 (months)	1-2 (years)	2-5 (years)	5-10 (years)	
15	3	1	0	1	20

Twenty children died within 24 hours of admission (Table 4), many only a few hours after their arrival in hospital, and these cases warrant separate consideration as they form almost 38% of the total number of deaths. The age distribution follows the general pattern so far demonstrated with the highest number in the under six months group, and a rapid decrease in number in the second half of the first year of life. An attempt was made to elicit any factors which might possibly account for the admission of so many children in a moribund state. Seven such infants had been ill for one to three weeks before admission, five had been ill for three to six days, and the remainder (eight) had a history of symptoms for two days or less. One striking feature

was noted; all the 15 cases under six months of age were artificially fed, so that nutrition and lack of immune response to infection may be factors worthy of consideration. It was also noticed that of the 28 infants under six months of age who did not respond to treatment in hospital no fewer than 24 were artificially fed. Thus 90% of infants under six months old succumbing to infection were artificially fed. The histories of two cases typical of this group are summarized.

Case Reports

Case 1. B.A.M., aged 3 weeks, with a birth weight of 6 lb. 2 oz. had a 'cold in nose' for five days. The infant took feeds well up to four days before admission, then began to refuse feeds. He was constipated for three days, but there was no vomiting, and no cough.

Examination on admission showed the general condition to be very poor, and the infant in a collapsed state with subnormal temperature, pulse 144, respiration 40. No abnormal signs were found in the lungs.

At necropsy there was consolidation of the upper and lower lobes on the left side, even more marked on the right side, but no other pathological findings.

Case 2. S.B., aged 3 months, of birth weight 6 lb. 12 oz., had been breast fed for one week only.

The infant had been ill for two weeks with vomiting and failure to gain weight. The vomiting, projectile in type, increased during the past week, and the bowels were constipated.

Examination on admission showed a moribund, dehydrated baby, with cyanosis of hands and feet, and practically no respiration. Heart sounds were very faint.

Necropsy showed a wasted infant, whose lungs were congested with oedema and consolidation in posterior parts of both lungs. There were no other pathological findings.

No definite diagnosis had been made in any of these children and no specific treatment had been given. The presenting symptoms in ten of these cases were refusal of feeds, vomiting, and diarrhoea. In four other cases convulsions were the first symptom. Thus attention was not directed to a disease of the respiratory system and this may account for the delay in instituting therapy. It is therefore important to bear in mind that the signs of parenteral gastroenteritis may completely obscure the primary infection; to avoid such catastrophes as those recorded, the lungs must always be considered as the possible primary site.

In recent years it has been reported that massive single dose therapy with sulphonamides has been highly effective in the treatment of pneumonia in infancy and childhood (Platt, 1940; Vollmer, Abler, and Rosenberg, 1944; Hesselman, 1947). This provides a short, convenient, and satisfactory method of treatment which can be carried out in the home

by the family doctor. In cases in which the diagnosis is not obvious, but where the possibility of pneumonia should be considered, this method will initiate the correct treatment although an early transfer to hospital and x-ray examination may be necessary to establish the localization of the infection. Considering the low toxicity of penicillin it may even be advisable to give a single massive injection of this drug in cases of doubt, such as those presenting with gastroenteritis or convulsions as the initial manifestation of bacterial invasion of the lungs, if by this means we can reduce the number of those infants who quickly succumb to the infection. Single massive dose treatment by the oral route with one of the sulphonamides or penicillin, which in infants under six months of age is readily absorbed from the alimentary tract, may commend itself because of the ease of administration; but the presence of vomiting so commonly encountered in these cases may render the method ineffective. The danger is that valuable time may be lost if only part of the chemotherapeutic dose is retained and proves inadequate to achieve a bacteriostatic level in the blood. A similar objection may be raised against the oral use of aureomycin, which has proved a valuable antibiotic in the treatment of bacterial and virus pneumonia of infancy and childhood (Olshaker *et al.*, 1949). However, because of its wider range of attack (which includes *Haemophilus influenzae* as well as pneumococci, streptococci, and staphylococci) and almost complete absence of toxicity, aureomycin may in future prove to be the drug of choice. Olshaker *et al.* reported 30 cases of bacterial pneumonia, including pneumococcal, streptococcal, and staphylococcal, as well as nine cases of atypical pneumonia; gratifying results were obtained in all but two cases. Aureomycin proved far less effective when given intramuscularly.

It has been generally accepted that white cell counts under 10,000 per c.mm. or over 50,000 per c.mm. are of serious prognostic significance. An analysis of white cell counts in this series reveals that no such prognostic importance can be attributed to a low total leucocyte count (Table 5). Of 23 infants with a count under 10,000 per c.mm. four died, while out of a total of 30 children with a white cell count of between 10,000 and 15,000 c.mm., six died. Furthermore it was found that the percentage of polymorphonuclear cells could not be used as an index of the severity of the disease. The number of polymorphonuclears varied from 20% to 80%, but there were approximately as many deaths recorded with polymorphonuclear percentages under 60 as above this level. Meyer (1931) attributed much more prognostic significance to the leucocyte count,

TABLE 5
LEUCOCYTE COUNTS IN 80 INFANTS UNDER TWO YEARS OF AGE

Age	5,000–10,000 per c.mm.		10,000–15,000 per c.mm.		15,000–20,000 per c.mm.		20,000–50,000 per c.mm.		Total	
	Recovered	Death	Recovered	Death	Recovered	Death	Recovered	Death	Recovered	Death
Under 6 months	12	3	11	5	8	2	2	3	33	13
6–12 months	3	1	5	1	7	1	1	1	16	4
1–2 years	4	0	8	0	1	0	1	0	14	0
Total	19	4	24	6	16	3	4	4	63	17

saying that it was inversely proportional to the mortality in 100 cases of pneumonia in infancy and childhood. Fleming (1936) similarly considered the leucocyte count of value in prognosis as a result of his study in adult pneumonia. In a study of the leucocyte count in croupous pneumonia in adults, von Wyss (1910) pointed out that leucopenia in itself is not a serious prognostic sign. It may be that improved methods of treatment now available for pneumonia have deprived the leucocyte count of its value in prognosis.

Summary

Two hundred and fourteen cases of pneumonia in infancy and childhood treated during 1946, 1947, and 1948 in two Manchester children's hospitals are reviewed.

The results of treatment with sulphonamides, penicillin, and combined sulphonamide and penicillin are compared.

The highest mortality occurred in infants under six months of age and combined therapy did not seem to affect the prognosis in this age group. There was a steep fall in the mortality rate for infants over six months but under one year of age, and a very low death rate for older children.

Attempts to lower the general mortality from pneumonia must be directed towards the treatment during the first six months of life.

Twenty cases died within 24 hours of admission

to hospital. Reasons for the delay in diagnosis are discussed.

Leucocyte counts in 80 infants under two years of age are given. No prognostic significance can be attributed to the total white count or to the percentage number of polymorphonuclears.

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