Note.—Throughout the paper "Staph. aureus" refers to coagulase-positive streptococci; coagulase-negative Gram-positive cocci are labelled "Staph. albus" or "micrococci."

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TREATMENT OF BRONCHOPNEUMONIA UNDER THE AGE OF ONE YEAR

BY

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Bronchopneumonia under the age of 1 year is generally considered to be a particularly severe disease, carrying a high mortality rate—up to 90% (Moncrieff, 1934). At the same time, unless complicating one of the acute exanthemata or an acute gastro-enteritis, it cannot be regarded as a common disease, and it is difficult to collect enough cases treated in hospital to enable conclusions to be drawn as to the efficacy of methods of therapy. During the severe winter of 1939-40 a number of infants suffering from various types of pneumonia came into hospital under my care, and of these I have selected those in whom the prognosis should have been poor—i.e., infants in the first year of life with extensive and widely disseminated patches of consolidation. The following is a brief summary of each case.

Case Reports

Case 1.—Female aged 4 weeks, admitted December 13, 1939. Severe bronchopneumonia following acute bronchitis, with consolidation of all zones of right lung and middle and lower zones of left. Maximum temperature 103° F., pulse 146, respirations 90. *Treatment:* Oxygen tent fourteen days; sulphapyridine 0.125 gramme four-hourly, total 5½ grammes; subcutaneous drip saline four days. *Feeds:* Two-hourly alternating breast milk and half-strength normal saline. In hospital twenty-four days.

Case 2.—Male aged 3 months, admitted January 9, 1940. Severe bronchopneumonia secondary to common cold. General condition poor. Temperature 99° F., pulse 160, respirations 72; maximum respirations 110. *Treatment:* Subcutaneous drip saline twenty-four hours; oxygen tent one week; sulphapyridine 0.25 gramme four-hourly, total 6 grammes. *Feeds:* Two-hourly, alternating humanized dried milk and half-strength normal saline. In hospital fourteen days.

Case 3.—Male aged 4 weeks, admitted January 20, 1940. Common cold followed by moderately severe bronchopneumonia. Consolidation of left middle and lower zones and right lower zone. General condition poor, with marked cyanosis. Temperature 100.4° F., pulse 200, respirations about 40 and irregular; maximum respirations 74. *Treatment:* Subcutaneous drip saline three and a half days; oxygen tent ten days; sulphapyridine 0.125 gramme four-hourly, total 3 grammes. *Feeds:* Two-hourly, alternating humanized dried

milk and half-strength normal saline. Convalescence complicated by abscess of chest wall with slow healing by granulation. In hospital eleven weeks.

Case 4.—Female aged 6 months, admitted February 1, 1940. Common cold followed by severe bronchopneumonia, with consolidation of right and left upper zones and right lower zone. Temperature 103.4° F., pulse 200, respirations 100 and irregular. *Treatment:* Oxygen tent; subcutaneous drip saline; sulphapyridine 0.25 gramme four-hourly. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline. Died in convulsions ten hours after admission.

Case 5.—Male aged 5 months, admitted February 9, 1940. Moderately severe bronchopneumonia complicating gastro-enteritis; marked dehydration. Maximum temperature 106° F., pulse 220 and irregular, respirations 124 and irregular. *Treatment:* Oxygen tent; sulphapyridine 0.25 gramme four-hourly; subcutaneous drip saline. *Feeds:* Two-hourly, alternating humanized dried milk and half-strength normal saline. Increasing cyanosis and death three days after admission.

Case 6.—Female aged 11 months, admitted February 22, 1940. Severe bronchopneumonia following a common cold, with consolidation affecting whole of left lung and lower zone of right. Infant showed typical features of cretinism, and, despite severity of pulmonary lesions, temperature, pulse, and respirations remained at a comparatively low level throughout the disease. *Treatment:* Oxygen tent ten days; subcutaneous drip saline forty-eight hours; sulphapyridine 0.25 gramme four-hourly, total 7 grammes. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline; feeding was very difficult. The pulmonary consolidation resolved and cretinism responded to thyroideum B.P., so that the infant was weaned and given a normal mixed diet. Unfortunately she later developed another cold, which was again complicated by bronchopneumonia, and this proved fatal. This case has previously been reported (Gill, 1940b).

Case 7.—Female aged 10 months, admitted February 29, 1940. Severe bronchopneumonia following a common cold. Consolidation of both lower zones and left upper zone. Temperature 104.4° F., pulse 188, respirations 68; maximum respirations 112. *Treatment:* Oxygen tent; sulphapyridine, initial dose 0.5 gramme, then 0.25 gramme four-hourly, total 4 grammes. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline. Condition complicated on third day by right pleural effusion, which was aspirated and found to be heavily blood-stained, but sterile on culture. Further sulphapyridine given intramuscularly, 1 gramme four-hourly; total 6 grammes. Relapse on fifth day and fatal termination with hyperpyrexia.

Case 8.—Male aged 8 months, admitted April 24, 1940. Common cold, followed by diarrhoea and later bronchopneumonia, affecting especially the right upper and middle zones. Temperature 101° F., pulse 136, respirations 64. *Treatment:* Oxygen tent forty-eight hours; sulphapyridine 0.5 gramme, then 0.25 gramme four-hourly, total 3½ grammes. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline. In hospital twenty-three days.

Case 9.—Male aged 11 months, admitted April 25, 1940. Acute bronchitis followed by severe bronchopneumonia, with consolidation of left middle and lower zones and right lower zone. Temperature 103° F., pulse 188, respirations 128. *Treatment:* Oxygen tent ten days; sulphapyridine 0.5 gramme, then 0.25 gramme four-hourly, total 6½ grammes. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline. Complicated on eighth day by right pleural effusion, which was aspirated and found to be heavily blood-stained, but sterile on culture. In hospital four weeks.

Case 10.—Male aged 6 months, admitted April 28, 1940. Moderately severe bronchopneumonia following acute bronchitis. Temperature 105° F., pulse 160, respirations 48; maximum respirations 60. *Treatment:* Oxygen tent twenty-four hours; sulphapyridine 0.5 gramme, then 0.25 gramme four-hourly, total 2½ grammes. *Feeds:* Two-hourly, alternating boiled cow's milk and half-strength normal saline. In hospital nineteen days.

Case 11.—Male aged 5 weeks, admitted May 18, 1940. Severe bronchopneumonia complicating gastro-enteritis, with consolidation of right upper and left middle and lower zones.

Temperature 102° F., pulse 160, respirations 92. *Treatment:* Ol. ric., hyd. cum cretae; oxygen tent ten days; sulphapyridine 0.25 gramme, then 0.125 gramme four-hourly, total 3 grammes. *Feeds:* Two-hourly, half-strength normal saline, later humanized dried milk. Condition complicated by acute generalized oedema, thought to be nutritional and responding within twelve hours to injections of vitamin B₁; later developed left *Staphylococcus aureus* empyema, which finally cleared after repeated aspiration. In hospital eight weeks.

Conclusions

From a study of these cases it was possible to draw certain conclusions.

Predisposing Causes.—In this series, as is usual, most of the infants were first taken ill with a common cold. There was a preponderance of males.

Prognosis.—It has long been recognized that in certain cases a fatal termination can be foreseen. Such cases are those which exhibit intense cyanosis, those complicated by repeated convulsions, and those which relapse after at first responding. It will be noted that each fatal case in this series falls into one of these three groups. The average time spent in hospital by the non-fatal cases was thirty-four days.

Mortality.—There were four deaths in the series—a mortality rate of 36%; this figure, while giving no grounds for complacency, is a great deal better than was expected after a consideration of previous figures for this age group. There was no doubt that this comparatively low mortality rate was mainly due to two therapeutic measures—the routine use of the oxygen tent and the administration of sulphapyridine.

Complications.—Apart from the more usual complications there was one in this series worthy of special attention—namely, the development of a haemorrhagic effusion in two cases. This has been noted in adults under sulphapyridine therapy, and may be a toxic effect due entirely to the drug.

Treatment

(a) *Sulphapyridine.*—No figures were available as a guide to the optimum doses—initial, successive, and total—and at first the dosage employed was largely a matter of trial. With experience, however, this was standardized and found to agree closely with that recommended by Barnett *et al.* (1939)—namely, 0.125 gramme four-hourly up to the age of 3 months, 0.25 gramme four-hourly from 3 months to 1 year; the initial dose was double the above.

(b) *Oxygen Administration.*—It will be conceded that there is no better way of administering oxygen to an infant than by the oxygen tent. All other methods interfere with feeding. Two types of oxygen tent were used in this series—the first a standard “infant” oxygen tent (supplied by Oxyginaire Ltd.; Fig. 1), the other a converted baby gas helmet (Fig. 2), as designed by Hartston (1939) and previously recommended (Gill, 1940a). In efficiency there was nothing to choose between them. Both used oxygen at the rate of 2½ litres a minute, and analyses of oxygen concentration inside the tents gave an average figure of 34% for the former and 37% for the latter. At this rate of flow cyanosis was abolished, and a higher rate of flow did not ease respiration further. The inside temperature was maintained at 70° to 74° F. by running the oxygen through an ice-container, and the infant was further protected against hyperpyrexia by light clothing, consisting only of a vest and napkin.

(c) *Feeds.*—These were maintained two-hourly, day and night, and half-strength normal saline *ad lib.* was alternated with feeds appropriate to the age of the infant. The results confirmed the view that fluids in quantity

are of greater importance than the caloric value of the feed. The majority of the infants were able to take from a bottle; a few were so weak as to require careful and patient feeding from a spoon or dropper.

FIG. 1.—Standard “infant” oxygen tent.

FIG. 2.—Converted baby gas helmet.

(d) *Sleep.*—In most cases, at some stage of the illness, chloral by mouth was most useful in ensuring sleep and soothing a restless infant.

(e) *Nursing.*—In no other disease is good nursing of greater importance, and once the physician had outlined the treatment the maintenance of the struggle rested almost entirely with the nursing staff.

Summary

An account is given of eleven cases of bronchopneumonia in infants under the age of 1 year, the mortality rate being 36%. It is concluded that this comparatively low rate was mainly due to the routine use of the oxygen tent and the administration of sulphapyridine. Suggestions are presented regarding the optimum use of these therapeutic measures.

It would be ungracious of me to close this account without expressing my appreciation of the skill shown by the nursing staff of the hospital in their constant attention to the infants comprising this series. I am also indebted to Dr. N. F. MacLagan for the gas analyses.

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