American Journal of Diseases of Children

Vol. 17

MARCH, 1919

No. 3

EPIDEMIC INFLUENZA IN INFANTS *

MARTHA WOLLSTEIN, M.D., AND ALTON GOLDBLOOM, M.D.
NEW YORK

When the present pandemic of influenza made its appearance along the Atlantic seaboard there was a general impression that children were not affected by the disease. This may have been justified at the very outset when the epidemic was limited to the military camps. As soon as the disease spread to the civilian population, however, cases among children of all ages became numerous. Thus, Dr. Hatfield¹ found that there were 50 subjects under 5 years of age among 339 patients treated in the contagious hospitals of New York City, or an incidence of 16 per cent. At the Babies' Hospital infants ill with influenza came for admission during the last week in September. From Oct. 1 to Nov. 15, 1918, 36 cases of "bronchopneumonia with influenza" were admitted, while during the same six weeks in 1917 only seven such cases presented themselves. This year (1918) 52 children came into the hospital with pneumonia between October 1 and November 15. Last year (1917) thirty-eight children with pneumonia were admitted during the same period; an increase of 14 cases, or of 37 per cent. The real significance of this increase, however, is shown by the mortality rate, which was 15.8 per cent. (6 cases out of 38) in 1917, and 57.7 per cent. (30 out of 52) in 1918.

The comparative incidence in mortality of all types of pneumonia admitted to the hospital during the same period of six weeks in 1917 and 1918 is shown graphically in the accompanying charts (Figs. 1 to 6, inclusive).

Narrowing down the pneumonia cases to those diagnosed as pneumonia with influenza, we find that there were seven such patients last year (1917), all of whom recovered. This year (1918), of 36 children who had bronchopneumonia and influenza, twelve recovered and twenty-four died, a mortality rate of 66.6 per cent. Of the 24 fatal cases, 18 came to necropsy and form the basis of this study.

* From the Babies' Hospital of the City of New York.

1. Hatfield, Hazel M.: Paper read at the meeting of the Woman's Medical Society of New York, Nov. 20, 1918.

The age of the patients ranged from 5 weeks to 21 months. Four children were less than 6 months old, 9 were under 1 year and 9 were between 1 and 2 years of age. There were 7 girls and 11 boys.

In nine cases no history of family contagion could be obtained. On the other hand, the mother had influenza in two instances, with fatal result in 1; the father, in another; two other children were ill in one family, and in three families one other child had the disease. Thus direct exposure to family infection was evident in seven of the little patients. Two children who had been in the hospital for several weeks with colitis were exposed to influenza there.

Fig. 1.—All pneumonias, October 1 to November 15.

Fig. 2.—Bronchopneumonias, October 1 to November 15.

Since these patients were not brought for admission until they had developed pneumonia, it is evident that the clinical symptoms of the early, uncomplicated stage of influenza in young children cannot be elucidated by a study of our series. Even the two cases which developed in the house were masked by the original disease of the patients. The temperature showed daily remissions of several degrees and was irregular; it ranged between 107 and 96 F. It became subnormal before death in some cases and rose before the fatal termination in others.

Cyanosis was marked in 3 cases, moderate in 5, absent in 8, and not noted in 2. Marked general redness of the throat was noted 9 times; 7 children had normal throats, and 2 were moribund on admission so that no examination was made.

In the fatal cases the leukocyte count varied. In 10 it was over 20,000. The highest number of white cells was 40,000. In 5 other cases the leukocytes varied from 12,000 to 17,000, which is scarcely above normal for children under 2 years old. One syphilitic infant

Fig. 3.—Lobar pneumonias, October 1 to November 15.

Fig. 4.—Bronchopneumonia with influenza, October 1 to November 15.

had only 8,400 white cells with 82 per cent. mononuclears. In the other cases the mononuclear cells varied from 22 to 58 per cent. The polynuclear leukocytes reached 78 per cent. and 71 per cent., respectively, in 2 cases of lobar pneumonia; and 72 per cent. in a case of bronchopneumonia of no greater severity or extent than 6 others in which the white cells were not above 60 per cent. The only patient who did not present any consolidated lung tissue at necropsy had had 34,000 leukocytes with 66 per cent. polynuclears, during life.

In no other instance was a count obtainable early in the disease, before the onset of complicating pneumonia. It may be said, however, that in this series of 18 cases a definite leukocytosis was found in 10, no increase occurred in 5 and a leukopenia was present in 1 syphilitic infant. Two children were admitted in a moribund condition and no blood examination was made. The leukocytosis was accompanied in every instance but one by a pneumonia. One patient without pneumonia had a white cell count of 34,000, and 5 patients

No. of Cases	
1917	2
1918	0
Recovered	
1917	2
1918	0
Died	
1917	0
1918	0

Fig. 5.—Lobar pneumonias with influenza, October 1 to November 15.

	PERCENT
TOTAL PNEUMONIAS	
1917	15.8
1918	57.7
BRONCHOPNEUMONIAS	
1917	17.4
1918	57.7
LOBAR PNEUMONIAS	
1917	22.2
1918	0
BRONCHO PNL WITH INFL	
1917	0
1918	66.6
LOBAR PNL WITH INFL	
1917	0
1918	0

Fig. 6.—Mortality, per cent.

with pneumonia had no rise in leukocytes. In other words, there was no definite blood picture in this series.

The average duration of the illness was seven days in these fatal cases; the shortest was four days and the longest, twenty-five days. Owing to the indefinite history given on admission, these figures cannot be accurately determined.

The complicating conditions which were present in those children who died of influenzal pneumonia were varied. One child showed

marked lesions of congenital syphilis; another had general miliary tuberculosis; 4 infants had ulcerative colitis, complicated in one by pyelitis; four were markedly rachitic. All these complications simply predisposed the patients to infection and were present before the fatal illness began. One baby developed pneumococcus meningitis before death, while two with ulcerative colitis and one with septic peritonitis developed marked abdominal purpura before the fatal termination.

BACTERIOLOGY

Cultures were made from the sputum before death in 17 of the 18 patients. *B. influenzae* was present 13 times: in overwhelming numbers, once; very numerous in 11; few in 1. Five times the organism was not found in the sputum, probably because of the difficulty of obtaining suitable specimens for culture from the prostrated patients. The other bacteria present were pneumococci, staphylococci, *Micrococcus catarrhalis* and streptococci, in the order of frequency. Only Type IV pneumococcus was found.

Fifteen cases came to necropsy. In all, the influenza bacillus was cultivated from both lungs in large numbers, but never in pure culture. It was found once in the heart's blood, together with the pneumococcus, and once in pus from an empyema. The only case of meningitis which developed among these children was due to pneumococci, and influenza bacilli were not present in the spinal fluid. The heart's blood was sterile in 8 cases; it contained the pneumococcus in 5. Pneumococci were grown from the lungs in 14 cases; streptococci once and *M. catarrhalis* 4 times. Twice *M. catarrhalis* was the only other organism found besides *B. influenzae*. Morphologically and biologically the influenza bacillus isolated from these children did not differ from the respiratory strains isolated from endemic cases in other years. It was a short, pleomorphic, gram-negative bacillus, strictly hemoglobinophilic, growing in characteristic dewdrop colonies on blood agar. On Dr. Avery's² oleate agar the colonies were larger and grayish. On animal inoculation the organisms also conformed to the respiratory strains, in that they were not pathogenic for rabbits or guinea-pigs; but they were less virulent for mice than is usually the case with strains of influenza bacilli isolated from the respiratory tract.³ The absence of the bacilli from the heart's blood except in one case, and the fact that no meningeal infections occurred are also in keeping with the low virulence of the organisms for animals. On the other hand, the failure of animal inoculation may be due to the highly "humanized" condition

2. Avery, O. T.: J. A. M. A. **71**:2050, 1918.

3. Wollstein, Martha: J. Exper. M. **22**:445, 1915.

of the bacillus. It is certain that it is highly invasive for every part of the respiratory tract, though it enters the blood stream so rarely.

In this country, Dr. Anna W. Williams⁴ found influenza bacilli in heart blood cultures made at necropsy 3 times among 30 cases studied. The commission reporting on influenza among British soldiers in France found the bacillus in the blood in 2 of 68 cases cultured during the acute febrile stage of the disease.⁵ Influenzal meningitis occurred in only 2 cases among the English soldiers. The low incidence of meningeal involvement is remarkable and points to an absence of meningeal strains of the influenza bacillus from this pandemic. The low percentage of positive blood invasion is also in keeping with the low average virulence of the respiratory strains of *B. influenzae*. This tends to substantiate the view that influenza alone is a disease which tends towards recovery in the majority of cases, and that the fatal issue is due, except in the comparatively rare instances of highly virulent respiratory strains of the influenza bacillus, to complicating secondary infections of the lungs with other organisms, chiefly pneumococci and streptococci. The meningeal strains, on the other hand, are almost invariably highly invasive for the blood stream and cause a suppurative leptomeningitis which is practically always fatal. We have, as yet, no accurate knowledge of the nature of the toxin produced by both meningeal and respiratory strains of *B. influenzae*.

PATHOLOGY

The necropsy findings on these 18 cases were very similar. The interest centered in the lungs, which contained a great variety of lesions in every case. Pleural exudate was present in 13 of the children; in 9 it was only an exudate of fibrin over the consolidated areas, varying from a thin layer to a sheet 2 mm. in thickness. In 4 cases fluid pus was present as well. The color of the lungs was bright red, due in part to intense congestion, in part to many subpleural hemorrhages (Fig. 7). Bronchopneumonia was present in 17 of 18 cases, accompanied by lobar pneumonia in 2, multiple lung abscesses in 2, and general mucopurulent bronchitis in every one of the 18 cases. Pulmonary edema was marked in 12 instances. A superficial emphysema was noted several times, over all the lobes. In none of the 17 cases with pneumonia was only one lobe involved. All lobes were involved in 3 instances; four lobes in 8, three lobes in 5 and two lobes in 1 case. Thus, in 16 of the 18 cases more than two lobes were involved. The

4. Williams, Anna W.: Paper read at the meeting of the Woman's Medical Society of New York, Nov. 20, 1918.

5. Influenza Committee of the Advisory Board to the D. G. M. S., France. Brit. M. J. 2:505. 1918.

character of the lesions varied greatly. The extent and migratory character of the pneumonia was shown by the fact that the lesions in the several lobes were not of the same age, but varied from small areas of peribronchitis to larger conglomerate areas occupying all or most of the lobe. Purulent infiltration was very marked, and abscesses

Fig. 7.—Section of lung showing congestion of the blood vessels in the pleura and hemorrhages just beneath the pleural surface.

had formed in two cases. Lobar pneumonia in the stage of gray hepatization was present in the right lower lobe in 1 case, while bronchopneumonia with hemorrhages was found in the other two lobes of the same lung and in one lobe of the left lung. The bronchitis was general, even in the lobes which were not involved in the pneumonic process.

There were subcapsular hemorrhages over the thymus, thyroid, liver, kidneys, suprarenals and lymph nodes; submucous hemorrhages in the larynx, trachea, stomach, intestines and kidney pelvis. The bronchial and mediastinal lymph nodes were swollen, edematous, red in color, often very deep red; and on section, small hemorrhages were

Fig. 8.—Section of lung showing suppurative bronchitis and areas of pneumonia about the bronchi. The exudate is chiefly polynuclear in character.

visible, usually one or two in a node. The spleen was congested; acute splenic tumor was present twice and chronic hyperplasia 6 times, due to syphilis in 1 and rachitis in 4. The liver showed no characteristic lesion. The kidneys were very much congested and showed marked parenchymatous degeneration, with punctate hemorrhages

beneath the lining of the pelvis, and about the apexes of the pyramids. The suprarenals were not enlarged or unduly congested. Subendocardial hemorrhages were noted once; petechial hemorrhages into the skin were present 3 times; but all these 3 cases were complicated, by ulcerative colitis in 2 and by septic peritonitis (*Staphylococcus pyogenes aureus*) in one.

On microscopic examination the lungs showed thrombi in many vessels, with hemorrhages into the alveoli. Edema of the vessel walls and connective tissue septa was very marked. The bronchi contained polynuclear cells and red blood cells; their walls were densely infiltrated and surrounded by alveoli packed with cells; chiefly polynuclear (Fig. 8). The alveolar contents were poor in fibrin, except in the lobar pneumonia lesions. The most marked and characteristic features were purulent infiltration of the alveolar walls and septa, hemorrhages and suppurative bronchiolitis. The capillaries and all the large blood vessels were distended with blood. Masses of bacteria were demonstrable in the bronchi and alveoli in one case, but with Gram's stain these were found to be cocci which retained the stain.

The other organs showed nothing characteristic on microscopic examination.

SUMMARY

To sum up: our eighteen cases showed a variety of pulmonary lesions making a characteristic picture of congestion, edema, general bronchitis, scattered pneumonia lesions differing in age, but involving two or more lobes; subpleural hemorrhages and pleural exudate. Capillary hemorrhages in the other viscera were constant. The influenza bacillus was grown from every case, but not alone. Pneumococcus Type IV was the most frequent bacterium associated with it. During life the sputum contained *B. influenza* in thirteen of seventeen cases in which it was searched for. This series of pneumonias was far more severe, more extensive and more highly fatal than was any other group of pneumonia cases observed in the hospital over a similar period of time.