AN EPIDEMIC OF VIRUS BRONCHOPNEUMONIA IN A BOYS' PREPARATORY SCHOOL

BY

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In 1934, at a boys' school in America, Gallagher took routine skiagrams of cases of epidemic respiratory infections. He found 16 cases with radiological opacities and the clinical features of a mild bronchopneumonia. Since then many epidemics of "primary atypical pneumonia of aetiology unknown" have been reported from all over the world, particularly in American Service personnel.

In this country, Herxheimer and McMillan (1942) reported on an epidemic of an "atypical influenzal pneumonia" in a public school. Daniels (1942) described an epidemic of bronchopneumonia of unknown aetiology in a girls' school in America. Thirteen out of 90 pupils developed the disease over a period of 43 days—an incidence of 14.4%. No staff or members of the faculty were affected—a point which is referred to below.

Young *et al.* (1943) reported on an outbreak of primary atypical pneumonia which occurred among hospital and medical school personnel. The incidence among students, resident nurses, and staff was 8.45%. The epidemic was thought to have originated in a laboratory instructor who was ill for 16 days with a cough while still at work. In the class taught by this instructor the incidence was 26.9%, 16 cases occurring in two weeks. In an outbreak of primary atypical pneumonia occurring at Camp Claiborne, Dingle *et al.* (1943) found an attack rate of 88 per 100,000 per week at the height of the epidemic in July, 1941. Focal concentrations among the units were rare, but the incidence was three times greater amongst the hospital staff than in the remaining troops. Of special interest in this report was the observation that, as well as 69 cases of primary atypical pneumonia, there were 34 cases of bronchitis clinically indistinguishable but showing no x-ray signs. They concluded that these cases represented a mild form of the same infection.

Snyder *et al.* (1952) reported on "an explosive outbreak of primary atypical pneumonia in a college community" in America. There were 19 cases among 118 pupils, an incidence of 16.1%. Fourteen occurred within the first four days. Cold agglutinins were positive in 8 out of 10 sera tested. There was no obvious response to several antibiotics, including chlortetracycline, which were used in treatment.

Serology

The agents responsible for primary atypical pneumonia have not yet been identified. The serology of the condition has been most informative, and two positive reactions have been established as occurring in some cases—the formation of cold agglutinins and the production of streptococcus MG agglutinins. The original theory that a raised titre of cold agglutinins is pathognomonic of virus pneumonia is no longer acceptable. Macauley (1951) has shown that it is a non-specific reaction indicating lung damage, although occurring most commonly in virus pneumonia.

Mirick *et al.* (1944) published evidence suggesting that a specific non-haemolytic streptococcus, MG, isolated from

patients suffering from primary atypical pneumonia, was the organism responsible. They found specific antibodies in the serum of patients recovering from the disease. It is now thought likely that this agglutination reaction is a non-specific one resembling the Weil-Felix reaction in typhus. The proportion of cases of primary atypical pneumonia showing this streptococcus MG agglutinin varies widely. Grist (1954), in a survey of virus pneumonia in Glasgow, found a rising titre of streptococcus MG agglutinin in only 0.1% of 771 cases admitted to hospitals with a clinical diagnosis of pneumonia. In comparison, the Virus Reference Laboratory (1953) reported that 8% of 553 sera sent from patients with respiratory infections showed a rising titre of streptococcus MG agglutinin. Those with a clinical diagnosis of virus pneumonia showed an incidence of 16%. Wormald *et al.* (1956) show that the proportion of positive streptococcus MG agglutinins varies enormously at different times of the year and in different localities. An epidemic incidence was present in Cambridge in November and December, 1954.

It is possible that all cases showing a rising titre to the streptococcus MG agglutinin are caused by the same virus, and that this virus is one of a number that can produce the syndrome labelled primary atypical pneumonia. The existence of the ordinary conception of virus pneumonia was challenged by Robertson and Morle (1951), who presented evidence that cases occurring in the R.A.F. were due entirely to an aspiration pneumonia following an upper respiratory infection.

The purpose of the present paper is to report an epidemic of virus bronchopneumonia that occurred in November, 1954, at a boys' school in East Suffolk in which 27 out of 108 pupils developed the disease—an attack rate of 25%. Sera from seven boys were tested. Four showed a fourfold rise in titre to agglutination with streptococcus MG. In the other three, in which the first specimen was taken too late to demonstrate a rise, convalescent MG titres were 1/320, 1/40, and 1/20. All these sera were negative in complement-fixation tests for influenza A and B, Q fever, and psittacosis group. Detailed serological results are given below.

Epidemiology

The school has over 100 pupils aged 8–12 living in a single large building in the country. It is very well equipped and has a trained nursing sister in charge of the sanatorium, in addition to a matron and several assistant matrons. The boys sleep in 10 separate dormitories and feed in a communal dining-room. They are in close contact in classrooms, gymnasium, changing-rooms, etc. The first case occurred on November 7, 1954, and the 27th on December 9.

Chart showing the day of onset of the 27 cases.

The Chart shows the even development of this epidemic. This is in marked contrast to the explosive nature of an epidemic of influenza.

Staff and servants in close contact with the boys numbered about 28. None of these developed the disease and only one member of the staff had an upper respiratory infection during this period. This absence of staff infection was also found in the epidemic described by Daniels (1942). It suggests that this particular strain of virus may have an age affinity similar to the common infectious virus diseases of childhood.

In the epidemic reported by Young *et al.* (1943) only one case suspicious of primary atypical pneumonia occurred amongst 402 home contacts of the disease. They concluded that under ordinary conditions of exposure primary atypical pneumonia is not highly communicable in comparison with the common cold or influenza. Another conclusion they drew from their epidemic was that if subclinical cases or healthy carriers occur they are probably of minor importance in transmission of the infection. The finding by Wormald *et al.* (1956) of significant streptococcus MG titres in a group of patients in Norwich in which there was no history or clinical evidence of virus pneumonia suggests that carrier states or subclinical attacks are indeed possible.

In the present epidemic careful supervision by sister and matron failed to demonstrate any subclinical cases. The origin of the epidemic was not found. Cases were evenly divided between dormitories and class-rooms, and there was no particular incidence in any part of the school. There was a marked absence of other respiratory diseases at the time of the epidemic and no cases clinically diagnosed as influenza were admitted during the whole term.

The question of closing the school was considered after about 10 cases had occurred. In view of the fact that most boys were not seriously ill, and taking into account the possible risks of spreading the infection in their households, it was decided to remain open until the end of the term. Parents were given the option of removing their sons if they wished to. On reflection and with all the facts of the epidemic in one's possession, it would seem that the high attack rate of 25% and the low risk of household infection (Young *et al.*, 1943) would make the serious step of closing a school for several weeks worth considering. However, the excellent response to correct treatment, once the diagnosis has been established, would seem to sway the verdict in favour of remaining open.

Clinical Features

In contrast to the usual textbook description of the disease, the onset was abrupt, with chills, malaise, and cough. Although in the early cases, before physical signs had developed, one was dealing with a P.U.O., the physician was left in little doubt that it was a chest infection of some kind. The predominant symptom was a harsh and extremely troublesome cough. In only 3 cases out of 27 was there any sputum, and in two of these it was blood-stained. Headache was moderate in severity and did not persist. There was no vomiting or diarrhoea, and only one patient had abdominal discomfort and anorexia. The appetites of the remainder were excellent throughout. The one patient with abdominal discomfort felt very ill for several days and the onset of jaundice was confidently awaited but never materialized. Upper respiratory catarrh was notable by its absence and there were no sore throats. Pleural pain did not occur in a single case.

Despite high fever and gross physical signs the great majority of patients felt quite well and their appearance greatly relieved their anxious parents. One boy had to be given phenobarbitone to reduce his abundant energy enough to keep him moderately quiet in bed. Fever at onset averaged 101–102° F. (38.3–38.9° C.) but was 103° F. (39.4° C.) in several cases and 104° F. (40° C.) in one case. The pulse was slow in proportion to the temperature. There was little or no cyanosis. In the early cases no physical signs were found in the lungs for the first two or three days of the

illness. Case 1 developed signs of consolidation at the right base with true bronchial breathing over a wide area on the fourth day. This was the only case to resemble lobar pneumonia. The other early cases developed, on the second or third day, an area of diminished air entry, in which could be heard moist rales, crepitations, rhonchi, and sibili. These signs were usually audible at one base or mid-zone and were occasionally bilateral. Dullness and reduced movement of the chest were never pronounced and auscultation was much more informative than palpation and percussion. The duration of physical signs in the early cases treated with penicillin and sulphonamides was considerable, and localized rales were still audible in several cases between the second and third weeks of illness.

There was no close correlation between physical signs and x-ray appearances, and it was quite usual to find that the chest had cleared radiographically although loud rales were still audible on clinical examination.

In some of the later cases generalized mild rhonchi and sibili were audible over the whole chest on the first and second days. If not seen during an epidemic a diagnosis of bronchitis would have been made. In cases not modified by chlortetracycline these signs usually became localized and more frankly bronchopneumonic. In 12 cases treated immediately with chlortetracycline 25% had no physical signs at any time, and 33.3% had only signs of localized bronchitis.

Signs outside the lungs were not found. There was no enlargement of the lymph nodes, spleen, or liver, and no pharyngitis. There were no complications.

Pathological and Radiological Findings

Blood counts were carried out in seven boys. There was no evidence of a leucocytosis or leucopenia. White counts averaged 6,000 to 7,000 and varied between 12,000 and 2,800. The differential count was not exceptional. Sputum was present in only three cases. Culture revealed a mixed growth of commensal organisms. Paired sera were tested

Serological Findings

Case No.	Day of Illness	Streptococcus MG Agglutination
1	15	1/320
	25	1/160
3	10	1/20
	20	1/20
4	12	1/40
	22	1/40
5	9	Partial 1/20 only
	23	1/40
7	7	1/10
	19	1/40
11	4	Negative
	16	1/40
13	3	Negative
	15	1/40

from seven boys by Dr. P. J. Wormald. The results are given in the Table. All these sera were negative in complement-fixation tests for influenza A and B, Q fever, and antigens of the psittacosis group.

Fifteen of the children were radiographed during their illness—eight during the active phase and in convalescence, and seven in convalescence in order to confirm that the chest was clear. The x-ray findings were typical of the pneumonitis so frequently reported in the literature and are not described in detail. More cases were not radiographed during the acute phase because it meant a 10-mile (16-km.) journey in an ambulance.

Diagnosis and Treatment

Case 1 was originally diagnosed as a lobar pneumonia, although the boy did not seem to be sufficiently distressed. As other cases occurred the epidemic nature of the condition soon became manifest. The diagnosis appeared to be either

influenza complicated by a secondary bacterial infection or primary atypical pneumonia. The clinical findings, the failure of response to penicillin and sulphonamides, the characteristic x-ray appearances, the sputum culture and white-cell count, and, finally, the serological results, all confirmed the diagnosis of primary atypical pneumonia.

All patients were strictly confined to bed and fed on a normal diet. Troublesome coughs were treated with linctus and inhalations of friars' balsam and steam. Breathing exercises were carried out with great enthusiasm.

The first nine cases were treated with penicillin and sulphonamides. In this group the duration of strict bed rest was 16 days. There was no obvious response to therapy. The next six cases originally treated with penicillin and sulphonamides for between three and six days were then treated with chlortetracycline, 125 mg. t.d.s., in the form of chlortetracycline syrup, for seven days. There was an immediate drop in fever on administration of chlortetracycline, but when given at this late stage it did not greatly hasten recovery. The duration of bed rest in this group was 14 days. The next 12 cases were all treated with chlortetracycline, 125 mg. t.d.s. on the first or second day of illness, and therapy was continued for seven days. Response was dramatic. Fever subsided almost immediately and rapid improvement took place. The average duration of bed rest in this group was 7.4 days.

Vitamin-B complex was given by mouth throughout all antibiotic treatment. No cases of intolerance to chlortetracycline developed and even mild gastro-intestinal symptoms were not experienced. The response to chlortetracycline in this epidemic is in line with the results of Meiklejohn and Shragg (1949) in their controlled series in which alternate cases were treated with penicillin and chlortetracycline. Prompt treatment with chlortetracycline is undoubtedly extremely effective in virus bronchopneumonia.

Convalescence.—The great majority of the boys were sent home to convalesce and did not attend school for the remainder of the term. Only three boys were well enough to return to school without a period of home convalescence. These three boys were all in the group treated immediately by chlortetracycline. It was felt that prolonged convalescence was desirable in children of this age in order to minimize any risk of lung damage.

Relapses

There was one early relapse. This occurred in the group treated originally with penicillin and sulphonamides and then with chlortetracycline. Cough persisted after he was up and about, and, although afebrile, he felt tired. His chest was clear on clinical examination, but x-ray examination revealed an area of pneumonitis at the base of the right upper lobe. A second course of chlortetracycline produced a rapid cure. The effectiveness of chlortetracycline in relapse was demonstrated by Meiklejohn and Shragg (1949).

Several boys were still coughing noisily when sent home for convalescence.

The next term began five weeks later. During the first week two of the boys who had had the bronchopneumonia the term before were admitted to the sanatorium with slight fever and cough. There were no physical signs and they soon returned to class. They continued to cough for several weeks.

A week later Case 1 of the previous term's epidemic was admitted to the sanatorium with slight fever, cough, and signs of slight bronchitis. He was treated with penicillin for a week but continued to cough and run a low fever. A chest x-ray film was clear and showed no evidence of pneumonitis. Nevertheless, physical signs were still present and he was given a course of chlortetracycline. His temperature settled slowly and he gradually recovered. He was

in the sanatorium for five weeks and was sent home to convalesce. No definite diagnosis was established, but it seems likely that he had a late relapse of virus bronchopneumonia.

Discussion

The special interest of this epidemic is that it occurred in a closed community, that the attack rate of 25% is the highest in the literature, and that in no previous epidemic reported has there been a positive streptococcus MG agglutination reaction in all sera examined. No conclusive proof has been obtained that "primary atypical pneumonia of aetiology unknown" is a virus disease, but the evidence is very suggestive. The identification of the agents responsible may be possible if specialist pathological assistance is obtained at an early stage in any subsequent epidemic in a school or institution. The latent period of several days which occurs before localized physical signs develop in most cases is a stage of great interest. Is it a period of virus septicaemia, or is the infection localized solely within the chest? Experience with this epidemic suggests that it may be a stage of silent bronchitis in the majority of cases, and of frankly audible bronchitis in the remainder. The development of more or less localized bronchopneumonia is the second stage of the illness and may never be reached in the mild case.

It must be uncommon for the chest physician to have the opportunity to examine a case during the first stage, and early diagnosis in the sporadic cases can never be easy. A syndrome of fever, cough, absence of toxæmia, and absence of physical signs may suggest the diagnosis, and chlortetracycline therapy can be begun as soon as any physical signs develop. If the diagnosis is firmly suspected it is not advisable to try the effect of penicillin and sulphonamides first, as the illness will be prolonged and chlortetracycline is infinitely more effective if given early in the disease.

With regard to the nomenclature of the disease, it is suggested that virus bronchopneumonia is much more descriptive and helpful than primary atypical pneumonia. The clinical findings are nearly always of bronchopneumonic pattern, and mention has already been made of the cases which resemble bronchitis. The latter will be less likely to be misdiagnosed if the bronchial nature of the condition is kept in mind through its title.

Summary

An epidemic of virus bronchopneumonia in a preparatory school in East Suffolk is described. The outbreak occurred in November and December, 1954. In the space of 34 days 27 out of 108 pupils developed the disease—an incidence of 25%.

Cases were evenly spread throughout the 10 dormitories and classrooms, which are housed in a single large building in the country. The origin of the epidemic was not found.

The clinical features are described with special reference to the abrupt onset, the signs of bronchitis, and the absence of complications.

The pathological findings are reported and a positive streptococcus MG agglutination reaction was present in all sera examined.

The diagnosis was confirmed by x-ray films in a number of cases. Treatment by chlortetracycline was found to be highly effective, especially if given early in the disease. One early and one possible late relapse are recorded.

Difficulties in early diagnosis are discussed briefly, and a theory of "silent bronchitis" is diffidently suggested to explain the absence of physical signs in the early stages in the majority of cases.

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THE PSEUDOSTENOTIC SYNDROME

OBSERVATIONS ON INTERMITTENT DYSPEPSIA WITH AND WITHOUT PEPTIC ULCER

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The cyclical pattern of dyspepsia in association with peptic ulcer has long been recognized but never satisfactorily explained, and it is well known that symptoms and radiological demonstration of a crater do not go hand in hand. Fifty-two patients with so-called ulcer symptoms were observed over a period of five to seven years. During this time they had intermittent medical treatment and repeated x-ray examinations. While the majority had the classical clinical and radiological features of peptic ulcer, some had also intermittent signs of duodenal ileus with or without ulcer pain. This led me to study the symptoms and x-ray signs of dyspepsia *per se* rather than as typical or atypical manifestations of an ulcer process.

It at once became obvious that in many patients there were two forms of discomfort: (1) the so-called ulcer pain relieved by eating, and (2) distension pain, sub-sternal and epigastric, the latter aggravated by eating and relieved by vomiting.

A master chart of the 52 patients clearly showed that these two types of symptoms were quite independent of each other, and that the current assumption that all dyspeptic signs in patients with recurrent peptic ulceration are associated with ulcer was probably false.

The pain of an ulcer is readily explained as being due to peritoneal irritation (analogous to pleural pain) or arterial occlusion, or to both. Distension pain has been ascribed, for want of a better explanation, to spasm. The distension symptoms are symptoms of intermittent obstruction, and careful examination of the x-ray findings during attacks of distension invariably reveal abnormalities of the mucosal pattern. These abnormalities consist of thickened or raised mucosa invaginating into the oesophagus at the cardia or across the pylorus into the duodenum. In many instances there were similar abnormal mucosal projections in the second and third

parts of the duodenum, and the appearances on screening corresponded to what has often been described as pendulum peristalsis.

When the x-ray appearances were correlated with the symptoms it was clear that, while ulcer pain was concomitant with a crater and changes characteristic of activity in the adjoining mucosal pattern, distension pain was associated with disordered mucosal pattern at the cardia and/or the pylorus. Both types of pain could occur together, but quite often they occurred independently. For convenience of description I refer to the latter as "pseudostenotic dyspepsia." The symptoms of pseudostenotic dyspepsia have not previously been described as an entity and merit detailed description.

Symptoms

1. *Symptoms Attributed to Distension of Lower End of Oesophagus.*—These comprise heartburn, acid regurgitation, waterbrash, hiccup, a sense of weight or distension over the xiphoid, substernal pain radiating to the back, towards the right or left scapula, and severe substernal pain radiating to one or both shoulders or mandible and resembling the pain of angina or of gall-bladder colic. Pseudostenotic dyspepsia at the cardia might start at any time: before, after, or even during a meal. But when already hanging fire the attacks would in most cases be evoked by sitting for some time in a hunched-up position—for example, driving a long distance; by a cold and fizzy drink; by eating very fast or having a large meal; or, very typically, by the recumbent position. Eating in a hunched-up position or bending forwards after a meal were found to be particularly apt to bring on the symptoms during the day. Some patients found relief from the pain or discomfort by walking, deep diaphragmatic breathing, taking bicarbonate of soda, or sipping warm water. Some experienced only the less distressing symptoms, but those who suffered from the more severe symptoms knew, without exception, the entire range from slight to severe.

2. *Symptoms Attributed to Distension of Pyloric Antrum.*—These include epigastric bloating after meals, belching, and nausea in the milder cases; and attacks of epigastric discomfort beginning about an hour after eating and increasing—sometimes accompanied by colic-like pains—until relief was obtained by spontaneous or self-induced vomiting in the severe cases. (It is interesting that the substance of the vomitus was only rarely the undigested meal and that it rarely contained free HCl; more often it was a clear bilious liquid.) In some cases the attacks began with localized pain in the epigastrium, similar to the typical pain experienced in duodenal ulceration. But in one patient with a duodenal ulcer the attacks started with a deep pin-pointed pain almost on swallowing the first bite of food and always before finishing the first course.

In some patients suffering from pseudostenotic dyspepsia one of the above types of symptom would be predominant for a while and then give way in favour of the other.

Unlike ulcer dyspepsia, which is a clearly cyclic disturbance, pseudostenotic dyspepsia does not seem to have any inherent rhythm, but occurs in what may be described as spikes or bursts of spikes on a graph which seems in some patients, who suffer also from recurrent peptic ulceration, to be superimposed on the rhythmic wave-motion of the ulcer activity.

No tendency to persist was observed, nor was there any predictable minimum spell of immunity as there seems to be in peptic ulcer. In the more severe cases of pyloric (epigastric) distension the symptoms were often very severe for a few days, then entirely absent for the next few days; then they returned. The duration of the symptoms in an attack ranged from seconds to several hours and seemed to be in proportion to their intensity. In many instances pseudostenotic dyspepsia followed closely on situations of strain. Several patients undergoing severe mental and emotional stress suffered from acute pseudostenotic dyspepsia which