INFLUENZA

A STUDY OF TWO OUTBREAKS

BY

C. M. OGILVIE, M.B.

Medical Registrar, Liverpool Royal Infirmary; late Graded Physician, R.A.M.C.

R. H. M. MAVOR, M.B.

Major, R.A.M.C.

AND

C. WEYMES, M.B.

Captain, R.A.M.C.

Between January 15 and February 22, 1949, outbreaks of Virus A influenza occurred at two military training centres in the Highland district of Scotland. These centres ("A" and "B") each had an approximate strength of 1,000 men and both received intakes of 80 to 100 recruits fortnightly. In Unit A 61 cases (6%) of influenza occurred, and in Unit B 141 cases (14%) (see Table). The nine smaller units in this district, each comprising a fairly static population of trained soldiers, reported only a few sporadic cases. We were able to observe all the cases in these two outbreaks.

Details of the Outbreak

	Duties	Time at Unit	Quarters	No. at Risk	No. of Cases	% Affected
UNIT A No. 1 Coy.	Recruits under training	Less than 10 weeks	Wooden huts; 1 window per 2 men; stove heating	140	20	14.3
No. 2 Coy.	" "	"	"	160	21	13
No. 3 Coy.	" "	"	Stone buildings; 1 window per 7 men; central heating	150	3	2
No. 4 Coy.	Clerical and administrative	4 months to 2 years	" "	140	2	Less than 2
No. 5 Coy.	" "	"	" "	360	15	4
UNIT B "A" Coy.	Recruits under training	Less than 10 weeks	Wooden huts; 1 window per 2 men; stove heating	250	35	14
"B" Coy.	" "	"	" "	250	40	16
"C" Coy.	" "	"	" "	250	29	11.6
"D" Coy.	Clerical and administrative	4 months to 2 years	" "	250	37	14.8

All cases of influenza were admitted to a military hospital (Unit A) or reception station (Unit B) within the camp. Daily clinical notes were made on all patients in Unit A from the onset of the epidemic; these will therefore be presented in greater detail.

Unit A

Symptoms.—The onset of the illness was usually rapid but not dramatic, and 18 hours was the average period elapsing between the onset and the reporting of symptoms. During the acute phase of the illness the following symptoms were experienced: fever, 49 patients; headache, 49; pains in the back, trunk, or limbs, 35; cough, 31; sore throat, 27; shivering, 25; sore eyes, 13; nausea or vomiting, 6; epistaxis, 3; diarrhoea, 2. In many cases the complaint of cough was made only in reference to the headache and chest or abdominal pains, which it aggravated; in only two patients was the cough productive. Hoarseness or nasal catarrh developed after a few days in about a quarter of the cases. Distressing symptoms persisted for an average of five days, and on discharge from hospital 38 men had minor residual symptoms—dry

cough, nasal catarrh, weakness, dizziness, hoarseness, or aching pains.

Signs.—None of the patients was seriously ill and no grave complications ensued. A blotchy flushing of the face with glistening eyes was the most constant feature; this flush was of a distinctly cyanotic hue in six cases. A slight injection of pharynx and fauces was noted in half the patients, but definite enlargement or infection of tonsils was present in only five. Two patients developed a catarrhal otitis media while in hospital, but this resolved without specific treatment. In six cases rales were present at one or both lung bases for over a week; these consisted of coarse-to-medium crepitations heard in both phases of respiration, uninfluenced by coughing and associated with local impairment of air entry. A chest radiograph in each of these cases revealed no focal changes and the white cell counts were within normal limits. Perhaps the most striking negative feature in this series was the relative freedom from gastro-intestinal disturbances: most of the tongues were remarkably clean, and many patients were able to take food even at the height of fever. Anorexia or vomiting did not persist beyond the first day.

Twelve patients were afebrile while in hospital. Of the remainder, the average duration of fever was 24 to 48 hours (over five days in only two cases). The average maximum temperature for the series was 101° F. (38.3° C.) (over 104° F. (40° C.) in three cases), and the fever reached its height more often in the morning or early afternoon than in the evening. Many patients showed a further spike of fever on the second day in hospital (usually the third day of the illness) after a fall of temperature on the previous evening. A lowered pulse/temperature ratio was a constant feature during the febrile stage; in the first few days of convalescence the pulse rate rarely exceeded 80 a minute, and in one-third of the patients readings of less than 60 a minute were recorded.

Convalescence.—Two patients were admitted with a recurrence of their original symptoms a few days after leaving hospital. The remainder were all seen one week after discharge from hospital; a few still had a mild upper respiratory catarrh, but all were fit and keen to return to duty. Mental depression and symptoms perpetuated by psychogenic factors did not occur in this outbreak.

Unit B

Clinical Aspects.—Patients from this unit reported sick more quickly, often within a few hours of the first symptoms. This was due in part to dizziness and faintness, which brought many straight from the parade ground. Apart from this common early symptom, the cases during the first half of the epidemic presented a clinical picture similar to those described above. Towards the latter part of the outbreak, however, the character of the illness changed and patients presented with nausea and vomiting associated with little or no fever and few respiratory symptoms. Ten men developed an illness of this type more than two weeks after recovering from an attack of the earlier variety: a different strain of virus may have been responsible for these second attacks, but Hirst tests for antibody titres were unfortunately not carried out on these men. Apart from one case of bronchopneumonia (this developed in the first week of the epidemic and responded well to penicillin), there were no serious or complicated cases in this outbreak. The average duration of illness was six days, and there were no problems in convalescence.

Laboratory Investigations

White cell counts were carried out during the febrile stage in 10 cases. All were within normal limits (4,000 to

10,000 per c.mm.), and the average of these counts was 6,300.

The Hirst test was performed in six unselected cases. Two specimens of serum were collected from each: the first was taken during the acute illness and the second 10 days later. The sera were examined at the National Institute for Medical Research, Hampstead, and at the Royal Army Medical College, Millbank. There was definite evidence of a virus A infection in all six cases; five of them showed an antibody rise against the classical PR8 strain of A, the sixth only against a new strain from the current Continental epidemic (A/Paris PL1/49). Antibody rises in human sera are of varying specificity as against different A strains, and one cannot be certain from such a result about which particular strain was responsible for this epidemic. It should be noted, however, that the "1949 A-prime" virus caused almost all the influenza in Western Europe last year, from Italy to Iceland.

Treatment

All patients were detained in hospital or reception station beds until at least 24 hours after fever and distressing symptoms had subsided; they returned to full duty within a week of discharge from hospital. Tab. codeine co., tab. acid. acetylsalicyl. et phenacet., or a codeine linctus when cough disturbed sleep provided a satisfactory relief of symptoms, and chemotherapy (penicillin or sulphadiazine) was given to those patients with signs of bronchitis.

The following prophylactic measures were adopted: immediate isolation of cases, opening of barrack-room windows, spacing of beds, and sprinkling of floors before sweeping. The training programme was not modified, and the movement of troops to, from, and within the camps was not restricted.

Epidemiological Features

The epidemiology of Virus A influenza in military units has been studied by Stuart-Harris (1945) in England and by the Commission on Acute Respiratory Diseases (1948) in America. The variability of outbreaks is emphasized in both these reports. This may be due to differences in the host, the infective agent, or environmental conditions. Stuart-Harris notes the potent effect of a frequent change of population in prolonging an epidemic, and records a higher incidence of influenza among recruits with the shortest residence in the community. The American workers found that the incidence among recruits and seasoned men was the same under comparable living conditions, and considered that environmental factors were mainly responsible for differences in the outbreaks which they studied.

We shall consider the incidence of cases in our series in the light of these observations.

Influence of Recruits

The Chart shows that, although the average daily incidence of cases was approximately the same in both units, the outbreak was confined to 13 days in Unit A but persisted for over 30 days in Unit B. The first two intakes of recruits to Unit B may have played some part in prolonging that epidemic, but these recruits did not experience a higher incidence of cases than the other men, and the third intake on February 17 escaped completely. Recruits arriving at the peak of the outbreak in Unit A did not affect the course of that epidemic, and none contracted influenza. The American workers also record the escape of an intake of

Chart showing daily incidence of influenza.

recruits at the height of an epidemic, and attribute this to a previous exposure to infection; antibody studies indicated that these men were largely immune.

Although Unit B contained a larger proportion (75%) of recruits than Unit A (45%), this was not directly responsible for the greater extent of the outbreak in Unit B, where the incidence among recruits and seasoned troops was the same. In Unit A there was a higher rate of infection among recruits than among seasoned troops, but the living conditions of the two groups were not comparable (see below).

The Infective Agent

An increase of upper respiratory infections (common cold, tonsillitis, pharyngitis, etc.) was noted during the fortnight preceding the influenza epidemic in Unit B (57 cases), but not in Unit A (17 cases). It is possible that infections of similar aetiology were diagnosed as influenza during the succeeding epidemic, and this may have contributed to the greater extent of the outbreak reported in Unit B. The occurrence of two clinical types in Unit B also suggests that more than one infective agent was active in this epidemic—either a non-influenzal organism or a variant of the predominant influenzal strain. This agent may have been introduced from the local town, where influenza was epidemic during the same period. Unit A was stationed 13 miles from the nearest town, and influenza was not epidemic in the surrounding villages.

Environmental Conditions

The table shows that the incidence of infection was 11.6–16% in six of the companies and 4% or less in the three other companies. These three companies (all in Unit A) were quartered in central-heated stone buildings, whereas the remainder occupied better ventilated but colder stove-heated huts. Although the total incidence of influenza in Unit A was higher among the recruits than among seasoned troops, this difference was not found where the living conditions of the two groups were comparable: No. 3 company of recruits, housed in the stone buildings, escaped with only three cases of influenza.

Living conditions thus appeared to influence the incidence of influenza, but cross-infection in "high-incidence" quarters was not a marked feature of this epidemic. In the outbreak reported by Milne and Cruickshank (1949), only one patient stayed in his quarters for over 24 hours, and 18 of his 20 comrades in the same hut developed influenza. In this epidemic fewer than five other cases developed in each of the 11 huts (20 men per hut), where men with influenza remained overnight and charts of bed positions revealed no significant evidence of bed-to-bed infection. Where a number of cases developed simultaneously it was usually found that they had all been

exposed to the same adverse conditions : nine soldiers developed symptoms within a few hours of a five-mile march in heavy rain, and other groups attributed their illness to a chilling consequent upon the over-zealous opening of windows in the sleeping quarters.

Stuart-Harris suggested that meteorological factors might determine the onset of an influenzal outbreak. We therefore obtained details from local Air Force stations of the conditions prevailing during January and February, 1949. No dramatic changes of temperature were associated with the onset or the peak of either epidemic, but rain fell on each day of the week preceding the peaks of both epidemics.

Discussion

These two outbreaks differ from those commonly reported in this country (Stuart-Harris, 1945) in that recruits and seasoned men were equally affected when living under comparable conditions. This finding suggests that the community had no recent experience of the infective agent. The new antigenic strain of virus which we reported had rarely been experienced in this country and would have been expected to provoke an equal incidence among recruits and trained men. We did not prove, however, that this strain was responsible for the epidemic as a whole. Furthermore, the American workers claim that the incidence of Virus A influenza of the usual antigenic types is not determined by the duration of residence in the community. This implies that Virus A influenza may not be an endemic disease. The behaviour of future epidemics in this country may be of interest in this connexion, but no definite conclusions can be drawn from the limited evidence which we have presented.

Differences of environment rather than of host susceptibility determined the variability of the American outbreaks, and overcrowding was responsible for the higher infection rate in certain groups. Our experience is similar, but exposure to cold seemed to play a greater part than cross-infection.

Summary

The incidence of influenza (Virus A) among troops in the Highland District of Scotland during January and February, 1949, is reported.

Epidemics were confined to two training centres. The form of these two outbreaks and the factors affecting the incidence and spread of infection are discussed.

Clinical features, laboratory investigations, and treatment are also described.

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REFERENCES

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Milne, D. G., and Cruickshank, J. D. (1949). *British Medical Journal*, **1**, 571.
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The Ministry of Health states that gifts of blood to the National Blood Transfusion Service for hospitals in England and Wales during the quarter ending September 30, 1949, were the highest since the war. They totalled 116,021, as against 95,301 in the comparable quarter last year. New donors enrolled in the quarter numbered 37,219. Also a post-war record was the total strength of the donor panels—376,502, or 9,335 more than a year ago. For the Welsh Blood Transfusion Region alone the figures for the quarter (with those for the comparable quarter in 1948 in parentheses) were: Donations, 4,005 (3,022); new donors 1,617 (866); strength of donor panel, 12,417 (11,421).

AUREOMYCIN IN TREATMENT OF PERITONITIS

BY

CHARLES A. BAILEY, M.D.

AND

CECIL V. JUMEAUX, F.R.C.S.Ed.

(From the Army Medical Department Research and Graduate School, Washington, D.C., and the Institute for Medical Research and the General Hospital, Kuala Lumpur, Malaya)

Recent observations have shown that the mortality encountered in peritonitis secondary to appendicitis, perforated peptic ulcer, and penetrating wounds of the abdomen has been reduced 60% by the post-operative use of variable combinations of sulphonamides, penicillin, and streptomycin (Altemeier, 1949; Pulaski, Voorhees, and Seeley, 1949). In spite of the better prognosis thus afforded, the case fatality is still between 5 and 10%. Consequently the search for more effective antibiotics to add to the surgeon's armamentarium continues. The new antibiotics chloramphenicol ("chloromycetin") and "aureomycin" have been used successfully in the treatment of generalized peritonitis incident to intestinal perforation complicating typhoid fever (Woodward, Smadel, and Ley, 1949), and in appendicitis and in carcinoma of the urinary bladder (Yeager, Ingram, and Holbrook, 1949).

During the course of recent investigations by the United States Army Medical Research Unit in Malaya several cases of generalized peritonitis were treated with the two new drugs. Those which received chloramphenicol are discussed in another article (Smadel, Bailey, and Lewthwaite, to be published). The present report summarizes the observations made on five patients treated with aureomycin who were suffering from peritonitis secondary to perforating lesions of the gastro-intestinal tract.

Clinical Observations

Three cases in the present group had acute appendicitis which resulted in rupture and peritonitis. Two of these three had generalized abdominal disease when in hospital. The third case was observed throughout the course of the illness but refused to grant permission for operation until after rupture had occurred; the fourth case developed peritonitis following perforation of a peptic ulcer; while the last of the group suffered perforation of the intestine late in the course of typhoid fever. Exploratory laparotomy and appropriate surgical procedures were done as soon as possible in the first four cases. The individual with the perforated typhoidal ulcer was treated with aureomycin alone without benefit of surgery.

Aureomycin ("duomycin")* was administered in the form of gelatin-coated capsules. Treatment was started one to three days after signs of peritonitis had appeared—that is, one to twenty-four hours after surgery was performed in those cases operated on. In general, an initial oral dose of 3 g. of aureomycin was given, followed by 0.25 g. every two hours for two days and then by 0.25 g. every four hours for the succeeding three to five days. Water in small amounts was administered along with the capsules during the acute phase of the disease.

Routine clinical and laboratory observations were made on the patients. Bacteriological studies were limited and no attempt was made to identify the bacterial flora of

*Aureomycin (duomycin) was supplied by Lederle Laboratories Division, American Cyanamid Company.