

Findings

The findings may be briefly summarized as follows:

1. Duration of illness: 2 to 21 days (average 7).
2. Race incidence: 5 Indians, 3 Chinese.
3. Age incidence: 19 to 42 years (average 27). It must be recorded here that only adults, as a rule, were admitted to these wards.
4. Number of days in hospital: 11 to 29 (average 19).
5. Fever: present in 6 cases.
6. Headache: present in 4 cases.
7. Giddiness: present in 2 cases.
8. Vomiting: present in 1 case.
9. Weakness of legs: present in 1 case.
10. Mental symptoms: present in 2 cases.
11. Hyperaesthesia: present in 1 case.
12. Neck rigidity: present in 5 cases.
13. Kernig's sign: positive in 2 cases.
14. Cerebrospinal fluid: (a) Cell count varied from 152 to 900 per c.mm. (b) Sugar varied from 10 to 84 mg. per 100 ml. 5 out of the 8 cases were between 45 and 60 mg. per 100 ml. (c) Chlorides varied from 627 to 745 mg. per 100 ml.
15. Cases not treated with sulphanilamide spent an average of 22 days in hospital, whereas those treated with it stayed there for an average of 16 days. From these figures it is impossible to draw any definite conclusion as to the therapeutic value of sulphanilamide, but the clinical impression was that cases seemed to benefit from its use.

Conclusions

Lymphocytic choriomeningitis is a disease that occurs not uncommonly in Singapore, and, unless one is on the look-out for it, cases might easily be missed. Headache was complained of in only 4 cases and neck rigidity in but 5 cases out of 8; only 2 had a positive Kernig's sign. One of the cases was simply a pyrexia of unknown origin, and there was no symptom or sign pointing to the central nervous system; this case would certainly have been missed if a lumbar puncture had not been done. It would therefore be advisable to bear this disease in mind when dealing with any obscure case with fever, headache, giddiness, or vomiting. There was no history of a similar illness occurring in the household or intimate contacts of these cases; none of them showed any evidence of infection of the ear, nose, or throat; and there were no sequelae.

Summary

A brief account of the literature on lymphocytic choriomeningitis is given, with reference to the clinical picture, aetiology, and pathology of the condition.

As no cases have so far been actually reported in Asiatics, 8 instances of the disease are described.

All the cases were seen at the General Hospital, Singapore.

The cases conformed to the characteristics described by Gibbens (1931).

There was no death, and no sequelae occurred.

A warning is given that unless one keeps on the look out for such cases they might be missed.

I wish to thank the ear-nose-and-throat department of the General Hospital, Singapore, for the examination of these cases, and the pathology department, Singapore, for the reports (cultures, W.R., Kahn tests, and precipitin tests). I am greatly indebted to Dr. J. V. Landor, physician, General Hospital, for his invaluable advice, and to the Director of Medical Services, Straits Settlements, for permission to publish.

REFERENCES

- Armstrong, C., and Lillie, R. D. (1934). *U.S. Publ. Hlth. Rep.*, **49**, 1019.
 Findlay, C. M., Alcock, N. S., and Stern, R. O. (1936). *Lancet*, **1**, 650.
 Gibbens, J. (1931). *Ibid.*, **2**, 12.
 Gibbens, W. (1937). *British Medical Journal*, **1**, 1063.
 Laubry, Ch., and Foy, G. (1910). *Bull. Mém. Soc. méd. Hôp. Paris*, **30**, 230.
 Rajam, R. V. (1936). *Brit. J. vener. Dis.*, **12**, 237.
 Rist, E., and Rolland, J. (1910). *Bull. Mém. Soc. méd. Hôp. Paris*, **30**, 245.
 Viets, H. R., and Warren, S. (1937). *J. Amer. med. Ass.*, **108**, 357.
 Wallgren, A. (1925). *Acta paediatr.*, Stockh., **4**, 158.

PATHOGENICITY OF GROUP C (LANCIEFIELD) HAEMOLYTIC STREPTOCOCCUS

BY

R. IRENE HUTCHINSON, M.B., D.P.H., D.T.M.
Emergency Public Health Laboratory Service

Until recently it was believed that Group C (Lancefield) haemolytic streptococci were not frequent in human disease (Evans, 1944), and that when they did occur mild infections only were produced. Harper and Williams (1944), in reviewing the frequency of streptococci in the healthy nose and throat, found them in about 47% of their cultures, and of these only 1.6% belonged to the Lancefield Group C. The Cardiff Public Health Laboratory (1943), analysing the pathogens from acute cases of upper respiratory infection, found Group C streptococci in 7.2%. In a summary of cases of puerperal infection associated with streptococci that were not Group A, Ramsay and Gillespie (1941) reported 12 in which the Lancefield Group C was found. The pyrexia was mild and the infection low-grade. Cases have, however, recently been reported in which these streptococci were associated with severe infections. Thus Portnoy and Reitler (1944) isolated such an organism in an outbreak of acute cellulitis in which 27 people were affected and 4 died. Fatal puerperal infection has also been recorded (Rosenthal and Stone, 1940).

During a period of two years in a very small Public Health Laboratory 105 strains of Group C haemolytic streptococci were isolated. They came from cases of disease and from routine swabbings of maternity staffs and patients and of children in residential nurseries. The comparative frequency of this group compared with the other Lancefield groups isolated during the same period (to a total of 970) was as follows: Group A, 618 cases; Group B, 69; Group C, 105; Group D, 71; Group G, 107. It will therefore be seen that the occurrence is approximately one-sixth of that of the Lancefield Group A streptococcus—frequent enough, if they are pathogenic, to warrant consideration.

Distribution of Group C Streptococci

Of these 105 strains 32 were found in routine swabbings of throats and 4 in routine vaginal swabbings of pregnant women. In these cases they appeared to be saprophytic. The remaining 69 strains originated as follows: Acutely ill cases, 9; mild tonsillitis, 33; suppuration of soft tissues, 12; puerperal genital tract, 12; sputum (chronic bronchitis), 3.

Analysis of Cases.—The most acutely ill case was that of a middle-aged man who developed bronchitis which led within 10 days to a basal pneumonia with pleural effusion. A severe toxæmia, swinging temperature, and tympanites later set in, and suggested a typhoid or other septicaemia. The blood culture yielded a Group C haemolytic streptococcus. Recovery ensued with penicillin therapy. One case of severe cellulitis occurred after a septic soft-tissue lesion. Infection spread down to the bone, and amputation of the terminal phalanx had to be performed. A dental abscess resulting in osteomyelitis of the zygoma also yielded a pure growth of haemolytic streptococci of Group C.

Six of the strains came from septic throats, in which the patient was very ill with a raised temperature, enlarged glands, and sloughing foul necrotic debris on the tonsils. Swabs were sent in for differential diagnosis between Vincent's angina and diphtheria. Neither of these was present, but an almost pure culture of Group C haemolytic streptococci was obtained in each case. It is interesting that the somewhat large number of cases of mild tonsillitis came from widely separated sources from general practitioners who had been consulted with a complaint of sore throat. The presence of a congested red throat and lack of any membrane or debris were always noted. No other pathogenic organisms were present in any of these cases, so that the Group C streptococcus was held to be responsible.

The 12 strains from soft-tissue lesions were from cellulitis, gunshot wounds, abscesses, and ulcers. A Group C streptococcus was the only organism present, except in the case of the gunshot wounds and ulcers of leg. In these a mixed flora of

The Illuminating Engineering Society has now reprinted the "I.E.S. Code for the Lighting of Building Interiors." This code was published in its original form in 1936 and has since been in great demand by all who are interested in the adequate lighting of homes, factories, offices, and public buildings. Copies may be obtained, price 1s. 6d., from the Society's office, 32, Victoria Street, London, S.W.1.

Staph. aureus (coagulase-positive), coliform bacilli, *Ps. pyocyaneus*, etc., was present. In no case was the patient acutely ill. Three of these 12 cases were associated with purulent discharges. Two were from vaginal swabs from an infant of a few months and a child of about 6 years, respectively. In neither case was any other pathogenic organism isolated, and although the children were not acutely ill they were definitely off colour and the local vaginal area and vulva showed much inflammation. The third case was that of a child with a copious purulent nasal discharge. The patient was suspected of being a chronic diphtheria carrier because of this discharge, but repeated examinations failed to isolate *C. diphtheriae* and always produced the Group C streptococcus.

Of the puerperal cases from which Group C streptococci were isolated from the genital tract, 5 were normal deliveries and the streptococcus was found solely as the result of routine swabbings. They caused no symptoms, and the puerperium was uneventful in each case. In 4 other cases with forceps delivery and extensive lacerations temperatures of from 99.8 to 101.8° F. (37.7 to 38.8° C.) were recorded and sustained for two to three days. Offensive lochia and uterine tenderness were noted. Rapid improvement and complete recovery followed sulphonamide therapy. In one of these the streptococcus was isolated from the throat and vagina before labour started; the other 3 had negative swabs on admission. Two patients after a normal delivery developed a mild pyrexia for a few days' duration (100–101.4° F.: 37.8–38.55° C.). Full recovery occurred. One patient, put into this category for convenience, was a gynaecological case. The trouble was diagnosed as uterine prolapse with cervicitis and erosion; colporrhaphy was performed, and she developed a mild pyrexia for a few days after operation. A pure growth of Group C streptococci was obtained from the cervix both before and after operation. The wound became clean and the patient recovered rapidly after sulphathiazole medication.

One strain was found on the anaesthetic machine of an operating theatre—a surprising finding, that suggests a possible source of hospital epidemic infection.

Significance of Group C Streptococci

It will be seen from the above series that in the majority of cases infection with these organisms does produce only mild lesions. In the genital tract they can exist as saprophytes, and, in spite of the local trauma of parturition, still cause no infection. With extensive lacerations, however, a mild uterine sepsis can be set up, so that the presence of these streptococci in the pregnant woman should always be noted. In the throat also the tendency is for a mild infection, but there is always a possibility of an acute and anginous inflammation. Infection of the soft tissues can be equally troublesome. In one of our cases it led to amputation of the phalanx of one finger, and in another to osteomyelitis of the zygoma.

It is difficult to assess the significance of the Group C streptococcus in the chronic bronchitis cases. Our 3 cases produced sputa with a mixed flora, but the Group C streptococcus very considerably outnumbered the other organisms. If not actually pathogenic, it would seem to be a great potential danger in view of the one case of bronchitis which led on to pneumonia and septicaemia. Here the patient was indeed gravely ill.

Bacteriology

All the strains gave clear-cut serological reactions with the Lancefield Group C serum, and soluble haemolysin tests were all positive. Biochemical investigation of 46 of our strains was carried out to see if there was any correlation between severity of lesion and type of streptococcus. All were inoculated into trehalose, lactose, sorbitol, and salicin-serum-peptone water, into plain broth, grown on 20% bile-blood, and tested for the presence of fibrinolysin. No correlation could be found between the severity of the lesion and the type of streptococcus causing it.

Sixteen of the 46 strains did not ferment sorbitol but fermented trehalose, thus fitting into Evans's (1944) description of *Str. equisimilis*. Of these 16, 4 did not lyse human fibrin and would therefore appear to be of animal origin. Of these 4, one was from a case of mild tonsillitis, one from a severe anginous throat, one from a chronic osteomyelitis, and the

last from a routine vaginal swab. The other 12 which lysed human fibrin, and would therefore seem to be of human origin, also came from lesions of varying severity, including a case of severe cellulitis, 3 mild puerperal infections, and 1 abscess. The remainder were from routine swabs, presumably from carriers on whom they were saprophytic.

The large group of organisms (30 in number) which did not ferment either sorbitol or trehalose were at first suspected of belonging to the *Str. equi* group. Further investigation, however, showed that they differed in other characteristics. All lysed human fibrin and fermented either salicin or lactose, or both. All grew rapidly in plain broth. Eighteen of these strains fermented both lactose and salicin, and included the strain isolated from the septicaemia. But as this group also included many of the mild tonsillitis and carrier strains pathogenicity did not seem to be particularly associated with it. Biochemical typing of the Group C streptococcus did not, therefore, appear to us at first to be of much practical value, but it was noticed that of 3 strains giving the same biochemical reactions (acid in trehalose and salicin, nil in sorbitol and lactose, positive for fibrinolysin, no growth in 20% bile) 2 were cervical swabs from mild puerperal pyrexial cases where these organisms were not grown from swabs taken on admission. The other was from the throat of a nurse in the same ward, thus suggesting the possible source of the infection.

Conclusion

It is suggested that the appearance of a Lancefield Group C haemolytic streptococcus in any lesion should be regarded with some degree of the apprehension which at present is bestowed on the Group A organism, and that, particularly in midwifery cases, its presence should be the signal for preventive measures to avoid cross- or auto-infection. Biochemical typing might be of value in tracing outbreaks of minor infection with Group C streptococci in maternity and surgical wards.

REFERENCES

- Cardiff Public Health Laboratory (1943). *E.P.H.L. Bull.*, Nov., p. 126.
 Evans, A. C. (1944). *J. Bact.*, **48**, 263.
 Harper, G. J., and Williams, R. E. O. (1944). *E.P.H.L. Bull.*, **3**, 86.
 Portnoy, B., and Reiter, R. (1944). *Lancet*, **2**, 597.
 Ramsay, A. M., and Gillespie, M. (1941). *J. Obstet. Gynaec. Brit. Emp.*, **48**, 569.
 Rosenthal, A. H., and Stone, F. M. (1940). *J. Amer. med. Ass.*, **114**, 840.

CHEMICAL WARFARE EXPERIMENT USING HUMAN SUBJECTS

BY

H. CULLUMBINE, M.D., Ch.B., M.Sc.

(Chemical Defence Experimental Station, Porton)

Human subjects have been employed for many years to assess the value of certain types of potential chemical warfare agents and the efficacy of suggested defensive measures. All the subjects were volunteers, originally from the staff of the Chemical Defence Experimental Station, Porton, but later from the three armed Services. No one was subjected to a test without first being told the precise nature of the test and the possible consequences to himself. The tests were chiefly routine in nature, and hundreds of volunteers have been used in this way; "volunteers from the volunteers" were invited for any test involving risk of injury. The tests for which the subjects were used were roughly of two types—viz., offensive and defensive.

Offensive Tests

The offensive tests included the routine assessments of hundreds of possible lacrimators and sternutators. Volunteers were exposed to these compounds, which were dispersed in low concentration in a gas-chamber, and the times of onset and the severity of the typical signs and symptoms of irritation noted. The potency of each compound was determined in this way by comparison with the effects produced by the common standard lacrimators and sternutators. The more promising compounds were further assessed under more realistic conditions. Thus trained troops "attacked" over an assault course while being subjected to heavy concentrations of sternutatory clouds from generators, and their performance was compared with that when under the influence of a cloud of a standard sternutator