Contact Carriers in Meningitis*

JOHN F. NORTON, PH. D., FELLOW A. P. H. A.

Department of Health, Detroit, Mich.

It is generally conceded that cerebrospinal fever (epidemic or meningococcic meningitis) is spread largely by healthy carriers. The control of the disease therefore depends upon the control of carriers. Measures leading to this end have been instituted under military conditions at various times in this country, in England, and in France. No attempt seems to have been made to control the movements of meningococcic carriers in a civilian population over any considerable period of time.

The number of cases of epidemic meningitis reported to the Department of Health in Detroit during the autumn of 1928 was unusually large.† In January, 1929, 66 cases (with 35 deaths) were reported as compared to an average of 3 for January of the 5 previous years. It appeared certain that an epidemic was in progress. Accordingly, the Commissioner of Health issued an order effective February 1, 1929, requiring the isolation of home contacts for a period of 14 days only, or until two consecutive nasopharyngeal cultures, taken not less than 24 hours apart, were found to be free from meningococci. Persons actually living in the apartment or house at the time the case was diagnosed as epidemic meningitis were considered contacts. In a few instances intimate or casual friends, who had been with the individual just before the illness began, have voluntarily requested that cultures be taken; but such persons when proved to be carriers were not officially isolated.

This report summarizes the experience in Detroit during the 6 months ending July 31, 1929.

Most of the cultures were taken by Department of Health nurses who were assigned to this work and carefully instructed. Some contacts came to the laboratory, but such a procedure was discouraged, particularly when street cars were used as means of transit. The cultures were taken from the nasopharynx with a swab on the end of a bent aluminum wire. The swab was then inserted in a sterile tube and placed in a towel between two warm water bags. Several calls

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† A complete report on epidemic meningitis in Detroit in 1928–1929 is in preparation and will be published later.
were made by each nurse before returning to the laboratory, and the warm water bags were refilled at each house. Upon reaching the laboratory the tubes containing the swabs were placed in an incubator and plated as soon as practicable.

The method described is not ideal, as is shown by the fact that about one swab out of seven failed to give growth on the culture medium, whereas when plates are inoculated immediately after taking material from the nasopharynx it is rare not to obtain growth of some organisms. We were unable to account satisfactorily for the difficulty. Addition of a little sterile distilled water to the tube containing the swab failed to correct this, so that drying of material was evidently not the cause. It was also found that frequently no growths were obtained from the cultures from persons who had recently gargled or were in the habit of using snuff or chewing tobacco. However, there were many more "no growths" reported than seemed desirable. Such a report was not regarded as a negative result for meningococci, and another culture was taken.

The medium used for growing the organisms was that generally recommended—meat infusion peptone agar of pH 7.6, containing 1 to 2 per cent of dextrose and 5 per cent of defibrinated sheep's blood. Plates were incubated not less than 18 hours before examination. Suspicious looking colonies were examined by means of smears stained by Gram's method, and when Gram negative organisms resembling meningococci were found an agglutination test was made. This was done by fishing suspicious looking colonies and suspending the organisms in 0.5 c.c. of salt solution (0.8% NaCl). Amounts of 0.05 c.c., 0.025 c.c. and 0.01 c.c. of a 1:4 dilution of diagnostic antimeningoococcic polyvalent serum were placed respectively in three tubes, and to each was added 0.1 c.c. of the suspension of organisms. A control tube was also prepared.

The tubes were shaken for 2 minutes, incubated at 37° C. for 1 hour, and immediately read. The amounts of serum used for the tests were respectively 0.0125, 0.00625 and 0.0025 c.c. Positive results were reported only when agglutination was obtained in the tube containing the smallest amount of serum (0.0025 c.c.) and the control negative.

The possibility of agglutination by normal horse serum was considered. A series of tests showed that some horse serums agglutinated meningococci in amounts of 0.01 c.c., but not in 0.0025 c.c. Three of the serums tested failed to agglutinate in a 1:10 dilution. Pooled serums behaved as might have been expected from the results with single serums.
We believe our technic has been similar to that used by others. Our aim was to obtain accurate results in as short a time as possible. It was necessary to release contacts negative for meningococci as soon as practicable. Twenty-four hours from taking the culture was as short a time as could be allowed for suitable reports.

From February 6 to July 31, 1929, 2,892 contacts with 619 cases were investigated, or an average of 4.67 contacts per case. For purposes of discussion the time is divided into 3 periods: February 6–March 31, April 1–June 1, and June 2–July 31. During the first period cultures were taken from 709 home contacts with 131 cases; 332 persons, or 46.8 per cent, gave one or more cultures positive for meningococci. During the second period cultures were taken from 1,406 home contacts with 310 cases; 207 persons, or 14.7 per cent, gave one or more cultures positive for meningococci. During the third period cultures were taken from 777 contacts with 178 cases, and 23, or 2.96 per cent, were found positive for meningococci one or more times. The percentage of positive contacts by weeks varied from 0.0 during the weeks ending June 23 and July 31, to 65.6 per cent for the week ending February 17.

The high percentage of carriers found during February, March and the first half of April is in striking contrast to many reports found in the literature dealing with military outbreaks of cerebrospinal fever; but is in agreement with figures given by Ostermann and by Bruns & Hohn, as quoted by Frost, for examination of home contacts. It should be emphasized that we were taking cultures only from persons who had been in rather intimate contact with patients.

Unfortunately, we were unable to obtain cultures from any large number of persons who gave no history of contact with meningitis cases. However, during April, 117 non-contacts were studied and 5, or 4.3 per cent, were positive for meningococci. Of 619 contacts during this same month 146, or 23.6 per cent, gave positive cultures. In July, no carriers were found among 169 non-contacts, while 8 carriers were located among 335 known contacts. Only one culture was made from each non-contact. As will be pointed out below this probably involves some error.

It is obvious that, as warm weather approached, the number of contact carriers diminished. The percentage of positives dropped markedly about 4 weeks before the peak of the epidemic, as indicated by the weekly reports of cases, was reached.

It was necessary to obtain more than one culture from a contact in order not to miss a considerable number of carriers. Of the 332 carriers detected during the period February 6–March 31, 236 gave
cultures positive for meningococci at the first examination; 89 were positive at the second examination after being negative at the first; 6 were positive after two negative cultures; and 1 gave meningococci after three unsuccessful attempts. With only one examination we would have missed nearly 30 per cent of our carriers.

By grouping the carriers according to age and sex, an effort has been made to determine the effect of these factors on the carrier state. Only the figures for the first two periods (February 6–March 31, and April 1–June 1) were used, since the number of carriers in the third period was too small for statistical purposes. Among 2,115 contacts, 1,091 were male and 1,024 female. Of the males 25.6 per cent were carriers (i.e., gave one or more positive cultures), and of females 25.4 per cent. Age appeared to have no influence on the carrier state. For example, 12.4 per cent of contacts were in the 5–9 age group, while 14.8 per cent of carriers were in this group. Fifty-eight and nine tenths per cent of the contacts were 20 years old and above, while 56.8 per cent of the carriers fell in this age group. The percentage of carriers to total contacts in each age group was slightly higher for the 1–4 and 5–9 ages, but the differences were too small to be of real significance.

Crowding is supposed to be a factor in meningitis. Presumably, in a civil population we would expect to find a higher percentage of carriers in crowded rooming houses than in residential districts containing 5 or less persons to a home. The 131 cases investigated between February 6 and March 31 were grouped on the basis of number of contacts per case. In the group with 4 or less contacts per case there were 51 cases and 157 contacts, of whom 64, or 40.7 per cent, were carriers. In the group with 5 to 9 contacts per case there were 71 cases and 446 contacts, of which 211, or 47.2 per cent, were positive. The final group, with 10 or more contacts per case, was composed of 9 cases and 106 contacts, of which 57, or 53.7 per cent, were carriers. These figures indicate a somewhat greater tendency for carriers to be found in the more crowded houses. However, the figures for the second period (April 1–June 1) show just the reverse, being 15.2, 15.2, and 11.9 per cent for the three groups respectively.

The persistence of carriers is a point of some importance. We were able to follow most of our carriers for 2 weeks but no longer, since that time was fixed in our isolation regulations. Again using the three divisions of the 6 months’ study—in the first period 32.8 per cent of carriers had not given two consecutive negatives before release, in the second period 25.6 per cent, and in the third period 30.4 per cent had not satisfactorily cleared up. While the advent of warm weather
was coincident with a great decrease in the number of carriers, proportionately the tendency to persist was about the same.

It is necessary to stress the uncertainty of obtaining accurate results in the detection of meningococccic carriers. We have had many experiences which convince us that conclusions from our laboratory data must be drawn with care. Either the carrier state is an intermittent one or our technic is not sufficiently exact—possibly both. Sometimes inconsistent results can be explained, but at other times not. One of our contacts gave the following results for meningococci, —, +, —, —, and accordingly was released. One week later she was sent to the laboratory by her physician because he found that she had been using a gargle during the time the last two negatives* were obtained. The next four examinations gave +, +, —, —. One month later she was still negative. This is by no means an isolated instance.

SUMMARY

This paper gives the results obtained by taking cultures of 2,892 home contacts with 619 cases of epidemic meningitis over a period of 6 months.

The percentage of carriers to contacts varied weekly, from 0 to 65.6 per cent. The highest percentages were found during the winter and early spring months, and the lowest during June and July.

More than one nasopharyngeal culture is needed to detect a considerable number of carriers.

Sex and age play no part in the tendency to become a carrier.

The number of persons in a house has no relation to the percentage of carriers found.

Carriers persist for 2 weeks as frequently in warm as in cold weather, although the actual number of carriers is greatly diminished.

As a result of measures instituted for the control of home contacts with cases of epidemic meningitis, 70 per cent of meningococcic carriers have been isolated until the carrier condition has terminated.

*Negative for meningococci. Other organisms are always present.

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REFERENCE