Editorial

The Dangerous Carrier of Hemolytic Streptococci

Among the most important problems in the field of communicable disease is that of the mode of spread of streptococcal infection. Little information concerning the origin of sporadic cases or of epidemics has been available. It is known that the carrier rate of Group A hemolytic streptococci is high when an epidemic of scarlet fever or streptococcal sore throat is occurring, but a high carrier rate does not necessarily result in an epidemic. The real significance of the high carrier rate was brought out by Schwentker[1] in his study of scarlet fever at Fort Warren, Wyoming, where he found that the greatly increased incidence of Group A streptococcus carriers which occurred in those companies exhibiting a high morbidity of scarlet fever was due to the epidemic strain, Type 19. But what initiates such an epidemic, *i.e.*, what constitutes the conditions which give rise to the initial cases has, up to the present, not been understood.

An observation made by Gordon[2] a number of years ago gave a clue to the elucidation of this problem. He found that scarlet fever patients who had had a complicating sinusitis or rhinitis were much more prone to cause secondary cases of scarlet fever after leaving the hospital than were the usual run of convalescents from this disease. The significance of this observation was not appreciated, probably because of the undeveloped state of the subject at that time. It was not until the recent war that further rapid progress in the understanding of the mechanism of transmission of streptococcal infection was made. The studies of Hamburger and associates, working under the Commission of Air-Borne Infections of the U. S. Army Epidemiological Board, clarified many little understood problems in this field and culminated in the discovery of the dangerous carrier of hemolytic streptococci.

The initial stimulus leading to their investigations was the finding that in certain hospital wards housing common respiratory disease the presence of Group A hemolytic streptococci in the throats of as many as 50 per cent of the patients resulted in no cases of streptococcal disease or of non-symptomatic infection of other patients, whereas in another ward a single carrier of one of these same types of streptococci might give rise to a number of cases of streptococcal infection. A second observation of importance was that when blood agar settling plates were put on each bedside table in a ward of scarlet fever convalescents, the number of hemolytic streptococci recovered from the air was consistently greater day after day beside one or two patients.[3] This lead to an intensive study of the environment of such patients and it was found that their bedding, clothing and the floor dust about the bed were much more heavily contaminated with streptococci (of the type

[1] Schwentker, F. The relation between scarlet fever morbidity and streptococcus carrier rates. *Am. J. Hyg.*, 38: 207–210, 1943.

[2] Gordon, J. E. Epidemiology of scarlet fever. A clinical approach. *J. A. M. A.*, 98: 519–523, 1932.

[3] Hamburger, M. Jr., Puck, T. T., Hamburger, V. G. and Johnson, M. A. Studies on the transmission of hemolytic streptococcus infections. III. Hemolytic streptococci in the air, floor dust, and bedclothing of hospital wards and their relation to cross infections. *J. Infect. Dis.*, 75: 79–94, 1944.

present in the throat) than were the environments of the other ward patients. It was then discovered that the individuals who produced such marked contamination of their surroundings were those carrying hemolytic streptococci in their noses.[4] Quantitative studies of the dispersal of streptococci by throat carriers on the one hand, and nasal carriers (who almost always had positive throats also) on the other, showed that the nasal carrier dispersed 80 to 100 times as many streptococci as did the individual carrying these micro-organisms in the throat but not in the nose. Nasal carriers of hemolytic streptococci were found most commonly among convalescents from streptococcal disease but a considerable number appeared quite well and gave no history of infection although an analysis of this latter group by means of antistreptolysin titers of the blood serum indicated that most of them represented missed cases.[5] Further studies showed that blowing the nose and sneezing produced the greatest dispersal of streptococci from the nasal carrier and that contamination of the hands, particularly from the noseblow, constituted the principal means of conveying streptococci to the immediate environment.[6]

Direct evidence that such carriers were dangerous came from an epidemiological study of cross infections in hospital wards and cases occurring in barracks.[7] Nearly all the hospital cross infections were traced to a single nasal carrier who exhibited a high "streptococcal output" while other carriers on the same ward putting out relatively small numbers of streptococci, with one exception, failed to spread infection. Similarly, outbreaks of streptococcal disease in barracks were traced to a single nasal carrier of the type causing the infection. This aspect of the study was amplified by Loosli, Lemon and co-workers,[8] also working under the Commission on Air-Borne Infections, to include the pattern of streptococcal contamination of the environment in relation to spread of disease among the occupants of the barrack. The most striking example of the menace presented by the nasal carrier dispersing large numbers of hemolytic streptococci came from the study of a food-borne epidemic of Type 1 streptococcal infection involving more than 100 convalescent patients who ate in the hospital mess.[7] The outbreak was traced to a "cold food handler" with strongly positive nose and throat cultures and tremendous contamination of the hands. The probable vectors were salad and pie which he sliced and wrapped separately "to keep each piece clean."

In an attempt to clear up the nasal carrier state, groups of such carriers were treated by Hamburger and Lemon[9] with sulfadiazine and penicillin. The most promising results came from the use of calcium penicillin in beeswax-peanut oil in a daily dosage of 300,000 units. Streptococci disappeared from the nose and throat shortly after beginning treatment and did not return in half the cases following cessation of the drug. Due to insufficient supply, it was not possible to continue treatment for more than five days.

[4] HAMBURGER, M. JR., GREEN, M. J. and HAMBURGER, V. G. The problem of the "dangerous carrier" of hemolytic streptococci. I. Number of hemolytic streptococci expelled by carriers with positive and negative nose cultures. *J. Infect. Dis.*, 77: 68–81, 1945.

[5] LEMON, H. M. and HAMBURGER, M. JR. Missed cases and contact carriers among nasal carriers of beta hemolytic streptococci. *J. Immunol.*, 54: 189–196, 1946.

[6] HAMBURGER, M., JR., GREEN, M. J. The problem of the "dangerous carrier" of hemolytic streptococci. IV. Observations upon the role of the hands, of blowing the nose, of sneezing and of coughing in the dispersal of these microorganisms. *J. Infect. Dis.*, 79: 33–44, 1946.

[7] HAMBURGER, M. JR., GREEN, M. J. and HAMBURGER, V. G. The problem of the "dangerous carrier" of hemolytic streptococci. II. Spread of infection by individuals with strongly positive nose cultures who expelled large numbers of hemolytic streptococci. *J. Infect. Dis.*, 77: 96–108, 1945.

[8] LOOSLI, C. G. and LEMON, H. M. Unpublished work of the Commission on Air-Borne Infections.

[9] HAMBURGER, M. JR., and LEMON, H. M. The problem of the "dangerous carrier" of hemolytic streptococci. III. The chemotherapeutic control of nasal carriers. *J. A. M. A.*, 130: 836–841, 1946.

These studies have contributed most important knowledge concerning the manner in which streptococcal disease is spread and point out the direction in which rational control may proceed. While it may not be wise at the present time to neglect the non-nasal throat carrier entirely, it seems quite evident that the nasal carrier of hemolytic streptococci provides the chief source of infection and that effective control of such carriers would constitute a long step forward in reducing the incidence of this disease. This knowledge should also be most helpful in resolving the confusion of the present quarantine regulations which keep scarlet fever patients isolated for varying periods of two to three weeks and ignore cases of naso-pharyngitis due to the same micro-organism.

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