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VACCINATION AGAINST TYPHOID FEVER.

BY HENRY ALBERT.

The term vaccination was originally used to designate the introduction of material from pustules of cows affected with cowpox into the human being to protect against smallpox. Such produced a mild form of the disease and conferred immunity to the more severe type as represented by smallpox proper. The vaccine represents, then, a weakened or attenuated form of the virus. The term, as now used, applies to the virus of any infectious disease,—the virulence of which virus has been diminished.

In 1886, Simmons and Frankel immunized small animals with living cultures of typhoid bacilli. The use of living cultures of bacteria even though their virulence has been diminished is obviously objectionable for immunizing human beings. It has moreover been shown that for certain diseases, dead bacteria will immunize quite as efficiently as living bacteria. The first vaccinations of human beings against typhoid fever were made with killed typhoid bacilli by Wright in 1896. Typhoid vaccines were used to some extent in the Boer war in 1900 but the value of the procedure was not thoroughly recognized until 1904 when the English and Germans began to use it extensively among the soldiers. In 1908 it was introduced into our own army—the submission to vaccination being at first entirely voluntary but was made compulsory in 1911.

To date more than 14,000 American soldiers and many thousands more of the English and German army have been vaccinated with very good evidence of protection against typhoid fever. In the earlier work the number of cases of typhoid among the vaccinated was about one-half that among the unvaccinated and the number of deaths from that disease only about one-fourth as high. With better technique, still better results have been obtained as shown by the fact that the recent figures indicate that the number of cases of and deaths from typhoid fever among the vaccinated is only about one-tenth as great as among the unvaccinated kept under the same conditions.

With the view of determining the factors responsible for the immunity and the extent of the protection, we made a series of examinations of forty-six medical students whom we vaccinated three months ago.

Technique of preparation and administration of vaccine;—The vaccine consists of a culture of typhoid bacilli killed by exposure for one hour to a temperature of 56° C. and the addition of 0.25% trikresol. It is injected into the subcutaneous tissue of the arm by means of a hypodermic syringe in three doses given at intervals of ten days—the first dose consisting of 500,000,000 typhoid bacilli and the other two of 1,000,000,000 each.

Reaction;—In four to five hours after injection, the site of inoculation becomes red, swollen and tender and remains so, usually for several days. About the same time general symptoms in the form of headache, malaise, slight fever, etc., also usually develop. These, however, always disappear within 48 hours.

The reactions which indicate immunity can, however, only be determined by an examination of the blood. These may be divided into the following:

1. Leucocytic—In about two hours after the injection, the number of white corpuscles of the blood becomes markedly increased—rising from the normal of about 7,000 to 15,000 or 20,000. The increase consists at first principally of polymorphonuclear neutrophile leucocytes but after several days principally of the large mononuclear type. The leucocyte count of the blood returns to the normal in about four days. The leucocytes appear to be associated with the production of the more specific immune bodies.

2. Phagocytosis, which refers to the ingestion of foreign material, such as bacteria, by leucocytes, is increase from one or two thousand times.

3. Agglutinins, the substances which cause the bacteria to lose their motility and to gather in small clumps, is also increased from 100 to 1,000 times the amount found in normal blood. These are of a specific nature, i. e., if induced by typhoid bacilli will react only on typhoid bacilli. They are the basis of the Widal test for typhoid fever.

4. Bacteriolysins, or substances that actually destroy bacteria, are also increased, but our present means of determining the quantity of such is very unsatisfactory.

Just how long the specific antibodies remain in the system is not known. The phagocytic index and the quantity of agglutinins is still

high (now 3 months after vaccination) in our cases. Clinical evidence seems to indicate that the immunity will last at least three years. Laboratory tests indicate that the quantity of specific antibodies formed in the body after vaccination is higher than that developed during the course of an attack of typhoid fever and inasmuch as one attack of typhoid fever apparently confers an immunity that lasts a lifetime, it is quite probable that one vaccination (three doses) will be quite as efficient for as long a time.

At the present time antityphoid vaccination is practically limited to the personnel of the army. They are especially subject to the disease by virtue of being frequently stationed in temporary quarters under unsanitary conditions. In view, however, of the harmlessness of the process and the valuable protection which it affords, vaccination against typhoid fever may well be much more widely extended especially among individuals liable to exposure to infection, as physicians and nurses or those who do considerable traveling. When typhoid fever is prevalent in a community it may well be applied to citizens in general.