

It is to the phagocytic power of the white blood corpuscles that Wright and Douglas and their followers have so successfully looked for aid to fight the morbid progress of several different classes of pathogenic organisms discussed further on. They have found it possible to artificially increase the production of opsonins in the blood by subcutaneously injecting into the patient a carefully measured quantity of vaccine (sterile bacteria). The increased phagocytosis which results, is not due to any direct stimulation of the leucocytes. The newly formed opsonins are in the blood serum and act in some unknown way on the bacteria, so changing them that the white blood corpuscles, or scavengers of the body, greedily eat them up.

The normal opsonic index, as discussed below, is 1.0, that is, there is in the blood of normal individuals practically an equal measure of opsonins. The object of opsonic therapy is to raise and maintain the opsonic index as high as possible above normal, for as long a period as possible, thus constantly preparing multiplying bacteria as palatable food for the leucocytes, until the infected individual has become immunised against the infecting organism.

TECHNIQUE.

To measure the amount of opsonins in the blood, we must measure the degree of phagocytosis. In other words, we must determine the opsonic index. There are three main elements necessary to determine the opsonic index, *i.e.*, leucocytes, blood serum, and bacteria.

1. Leucocytes: Ten to fifteen drops of blood are dropped into a solution of sodium citrate in physiological salt solution, gently mixed, and then centrifuged five minutes. The leucocytes are thus washed free of serum and are to be found in the upper layer of corpuscles after the supernatant salt solution is drawn off.

2. Blood serum: A few drops of blood are drawn into a glass capsule, the capsule sealed and centrifuged so that the blood corpuscles are thrown to the bottom, leaving the clear serum on top.

3. Bacteria: The bacteria which are causing the disease to be treated are grown on agar for twenty-four hours, the growth scraped into physiological salt solution to form an emulsion, mixed thoroughly and diluted so that there will be about one to two germs to be ingested by each leucocyte.

Equal volumes of leucocytes, blood serum, and bacterial emulsion are drawn into a capillary pipette and mixed by blowing back and forth on a glass plate. The end of

the pipette is sealed and the whole incubated for fifteen minutes. The contents are then mixed as before, spread on slides and stained. The number of bacteria ingested by fifty leucocytes is divided by the number obtained when the blood serum of a normal person is used in place of the blood serum from the patient, and the quotient is the opsonic index of the patient.

BACTERIAL VACCINES.

Bacterial vaccines are emulsions of a known number or weight of dead bacteria in physiological salt solution.

The bacteria are grown in large quantities on agar and the growth washed off with salt solution into large glass tubes, which are then sealed. The clumps of bacteria are broken up by shaking the emulsion vigorously for an hour. The number of bacteria per c.c. is then counted. There are sometimes as many as seven thousand or eight thousand million bacteria per c.c., so that the counting is done by diluting a minute but definite amount of the emulsion with a known amount of salt solution, and comparing the number of bacteria in this diluted portion with the same volume of blood which we know contains five million blood corpuscles per c.c. The original emulsion is diluted with salt solution to a convenient strength for administration. The vaccine, after being kept at 60 degrees C. for an hour to kill the bacteria, is stored in brown bottles with rubber surgeon's finger tips fastened over the mouths of the bottles. Every step in the preparation must be taken with great care, so as not to contaminate the vaccine. Before administering it, however, some of it is withdrawn from the bottle and planted on agar to see whether it is sterile. If no growth appears, the vaccine is pronounced sterile, and will keep indefinitely. To give a dose of vaccine, the rubber top is dipped in lysol, the bottle held inverted, the rubber top pierced by a sterile hypodermic needle and the required amount of vaccine withdrawn into the hypodermic syringe, and injected subcutaneously. The tubercle vaccine is prepared by weight from Koch's new tuberculin.

Certain general principles of treatment can be learned by a study of a large number of cases.

1. A dose of vaccine causes a rise in the opsonic index usually on the second or third day, followed by a gradual drop until it reaches 1.0 or below. There may be many variations from this.

2. Vaccine should be given when the opsonic index remains stationary about or below the normal line. This commonly occurs between the seventh and tenth days.

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