

INFECTION.

ITS CAUSES, ITS MODES OF TRANSMISSION AND ITS
PREVENTION.

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THE pathogenic microbes differ very much among themselves in the degree of their disease-inciting power; such power is known as "virulence." Variations in virulence occur not only among different species of pathogenic bacteria, but may occur within the same species. Pneumococci for instance, which have been kept upon artificial media or in other unfavourable environment for some time, exhibit less virulence than when freshly isolated from the bodies of *man* or animals. It is necessary, therefore, in order to produce infection, that the particular bacterium involved shall possess sufficient virulence.

Now the natural defenses of the body against the invasion of bacteria are three in number, viz :—

- (1) An unabraded and healthy mucous membrane.
- (2) The Hydrochloric Acid of the gastric juice which is secreted on the entrance of food into the stomach at a time when the bacteria are also present.
- (3) The natural antagonistic action of certain substances present in the liquids and cells of the body. This action is sometimes referred to as the "bactericidal action" of the serum or as due to the presence of defensive proteids or alexins.

Whether or not the infection occurs depends upon three things, viz. :—

- (1) The number of bacteria which gain entrance to the animal tissues. A small number of bacteria, even though of proper species and of sufficient virulence may easily be overcome by the first onslaught of the defensive forces of the body. Therefore bacteria must be in sufficient number to overcome local defences and to gain definite foot hold and carry on their life processes before they can give rise to an infection.
- (2) The degree of virulence of the infective agent. The more virulent the germ, other conditions being equal, the smaller the number necessary for the production of disease, *e. g.*,

the introduction of the single individual of the Anthrax species, it is claimed, is often sufficient to cause fatal infection.

- (3) The degree of resistance of the body to the invasion, which is in the main due to antagonistic substances in the tissues of the body.

Modes of entrance of bacteria into the body :—

Bacteria may enter the body.

- (1) By direct inoculation through a broken surface of the skin or mucous membrane, as in the case of Glanders, Syphilis, etc.
- (2) By simple application to an unbroken mucous membrane, as in Gonorrhoea and purulent Ophthalmia.
- (3) By inhalation of air, as in Small-pox, Diphtheria, Tuberculosis, etc.
- (4) By swallowing of water and food as in Enteric Fever and Cholera.

Many diseases conveyed generally by inhalation or swallowing can also be communicated by inoculation, *e. g.*, Tubercle.

The way by which bacteria gain entrance to the human body is of great importance in determining whether or not disease will occur, *e. g.*, Typhoid Bacilli rubbed into the abraded skin may give rise to no reaction of importance whilst the same micro-organism if swallowed may cause fatal infection. Conversely, virulent streptococci when swallowed may cause no harmful effects while the same bacteria rubbed into the skin may give rise to severe reaction.

Action of bacteria within the body :—

The bacteria having gained entrance into the body, there first occurs a period of incubation. In this period the micro-organisms apparently lie in a dormant or latent condition for some time which varies according to the disease and within limits even in the same disease. To this succeeds the period of invasion when the symptoms are first manifested; after this, in the case of exanthemata and some other diseases comes the eruptive stage, when the specific symptoms make their appearance, then comes the stage of defervescence terminating in recovery. This stage indicates that susceptibility to the particular infection is exhausted either because the microbe itself is unable to continue its growth and development owing to the formation of chemical products known as antitoxins, which prevent it doing so, or because of the resisting power of the body, the strength of its defensive forces being superior to the strength of the attacking force. In the great majority of cases the body remains insusceptible either throughout life or for a longer or shorter period to any other attack of the same disease. It may also be remembered that

in some diseases no such period of decline occurs, *e. g.*, in Tubercle, Syphilis etc., and the disease advances and terminates in death.

Exit of the bacteria from the body :—

The specific poison, *viz.* the bacteria, that is developed in the body in the course of the disease as already stated is present in large quantities at the sites of the specific lesions and it is from these spots that it is discharged. Thus in Cholera and Enteric Fever the principal lesions are in the intestines, the microbes, the *Bacillus Typhosus* and *Cholera Vibrio*, are discharged in the faeces and in the urine. Similarly in Small-pox the skin eruption contains the virus and the shed epithelial scales and debris carry it away. In Diphtheria the virus is contained in and discharged with diphtheritic membranes and mucous secretions from the throat. In Measles, Whooping Cough and Influenza the discharges from the respiratory mucous tract carry off the respective contagia. In Syphilis the discharge from the initial sore is infective as this contains the virus known as *Spirochetæ Pallidæ*.

Virulence and behaviour of the bacteria outside the body :—

The virulence of the specific microbes outside the body is manifestly very different in different cases, *e. g.*, in Small-pox and Scarlatina poison can be conveyed a great distance in clothes, etc. and retains its virulence for a considerable time. In these cases the existence of the virus outside the body seems generally to be of a latent or dormant nature and may undoubtedly be capable of development and multiplication in some suitable nutrient medium such as milk. In Measles, Whooping Cough, Diphtheria, the virus is transmitted to a limited, but still considerable, distance from the diseased body and is not rapidly destroyed. With regard to Enteric Fever and Cholera however there can be little doubt, if any, that the specific germs are capable of living, growing and multiplying under suitable conditions in soil and water and other media. The micro-organisms connected with these diseases are facultative Saprophytes. The differences of behaviour of the different micro-organisms are obviously of great importance in reference to the measures to be taken to prevent their propagation.

Modes of Transmission of Infection :—

These will be easily understood from the consideration of the points just mentioned above, *viz.*, the mode of discharge of the specific virus from the body, its mode of entrance into the body and its behaviour and virulence outside the body. Thus inoculation of the discharge from the Syphilitic sore through the broken skin or mucous membrane of a healthy body will communicate syphilis. This infection is known as immediate or direct, *i. e.*, from the sore to the skin or mucous membrane, but it may be intermediate or indirect through the use of a pipe smoked by a syphilitic patient to which has adhered some syphilitic discharge. Where the

poison is discharged in the evacuations and taken into the body in food or water as in Cholera and Enteric Fever, it is through the contamination of food or water by these infective materials, that the disease is spread in most cases. This does not exclude the possibility of the virus being inhaled or swallowed with air in the form of dust; but more commonly the dejecta find their way into some source of water supply or milk supply or some article of food and so enter the alimentary canal.

Where the poison is discharged from the skin or from the mucous membrane of the respiratory tract or mouth and nose, it is diffused through the air and may be inhaled or swallowed by healthy persons, so propagating the disease, *e. g.*, Small-pox, Measles, Whooping Cough, Influenza, Diphtheria, etc.

In Scarlatina and Diphtheria the infection is said to have been conveyed by swallowing milk to which the specific virus has gained access from the air. Tubercle is commonly propagated by inhalation of air containing the Tubercle Bacilli thrown out in sputa of persons suffering from the disease and sometimes by swallowing milk which has been specifically infected from the cow, or the meat of a tuberculous animal. Therefore in all cases where the poison is given off in discharges any articles that are used to receive those discharges such as handkerchiefs, rags, towels, etc., are themselves infective and if allowed to become dry will in turn, give off infective particles into the air ready to be inhaled or swallowed.

I am afraid I have dilated on the subject too much but before concluding it, I hope it will not be out of place to mention the instructions drawn out for the nurses of this hospital for the prevention of Enteric Fever admitted into the hospital, of the propagation which may also be applicable to other infectious diseases.

(To be concluded.)