

THE RÔLE OF THE SKIN IN THE PRESERVATION OF HEALTH

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IT is commonly known that the skin serves to protect the inner organs from various harmful effects. Whereas in many animals it is covered by special hard structures, such as scales, which protect it from injuries, in man and the majority of mammals the skin forms a tough and elastic tissue which is easily damaged. Sometimes the slightest lesion of the skin will allow various microbes and parasites to penetrate through it and provoke grave disease both in the skin itself and in the organism. Infection with such diseases as small-pox, anthrax, staphylococci, and streptococci, syphilis, etc., takes place mainly through the skin.

Until quite recently the idea prevailed that the skin played only a passive rôle in the defence of the organism. According to METCHNIKOFF'S theory, the chief protective agents of the skin are the phagocytes which are conveyed to the skin with the blood. It has recently been shown, however, that the skin itself is capable of taking part in the defence reactions of the organism, independently of phagocytosis.

This function of the skin was convincingly demonstrated by the brilliant works of BEZREDKA on local immunity which provided new methods of immunization of the skin against various diseases.

As is known, the skin consists of the following two layers: the outer *epidermis* or cuticle and the inner *dermis* or corium. The epidermis consists of flat epithelial cells arranged in several layers. Those of the upper layer (*stratum corneum*) become dried and are cast off, carrying away with them the dirt and various microbes adhering to the surface of the skin. This layer rests upon hyaline cells composing the *stratum lucidum*, below which is the so-called Malpighian layer. This layer consists of several rows of cells interspersed between which are numerous lymphoid cells.

The remarkable complexity of the structure of the skin is in keeping with the variety of functions it performs.

In the first place, the skin acts as an extremely resistant and elastic barrier protecting the body from the penetration of various parasites. The skin is permeated by countless sensory nerve endings which serve to collect and conduct the various sensations, such as cold, heat, pain, touch. These sensations give warning of danger and cause the organism to react accordingly. Apart from this,

there are other important functions of the skin. One of these is respiratory: The skin absorbs oxygen and discharges carbon dioxide. It also serves to regulate the temperature of the body. This is effected by the activity of the sweat glands. At high temperatures the perspiration becomes more vigorous and causes increased evaporation which in its turn leads to a lowering of temperature of the body.

Lastly, there is the excretory function, many harmful products of metabolism being eliminated from the organism in the sweat. The skin shares this function with the kidneys and thus relieves the latter of some of its work. The magnitude of this work is illustrated by the following figures: an adult loses about $\frac{1}{47}$ of his weight, or 1 kilogram in fluid, through the skin per day.

The skin thus serves not only as a protective tegument, but also as an organ of definite physiological processes of vast importance in the life of the organism.

Its rôle is of special importance in the defence of the organism against various parasites and microbes, i.e. in immunity, both natural and acquired. If man is able to protect himself against the invasion of the numerous microbes this is due entirely to the defensive activity of the skin.

The skin contains an enormous army of phagocytes, some of which are motile and others stationary, which rapidly engulf and digest the microbes that have penetrated into the skin.

In cases, when the microbes prove to be very resistant and the local phagocytes are unable to overcome them, numerous minute phagocytic cells or microphages come to their assistance. These cells are always present in the blood and, when the necessity arises, they penetrate through the walls of the vessels and attack the affected site. A real battle then ensues which frequently ends in the destruction of the microbes. Sometimes, however, the microphages prove to be unequal to the struggle and perish themselves. Then large numbers of macrophages, or large phagocytes, appear on the scene. These cells, which are capable of stronger resistance, join the issue and often ingest and destroy the weakened microphages together with the microbes.

The process does not always end here, however. Very often the microbes produce poisonous substances or toxins which gradually poison both the microphages and the macrophages, while they themselves begin to multiply intensively. This state of affairs results in two remarkable phenomena.

In cases when the infected focus is in or under the skin, an abscess is formed at the site. The infected focus becomes surrounded by large numbers of microphages and macrophages, and a barrier is formed on its lower surface, preventing the microbes from penetrating beyond it into the inner tissues. This barrier surrounds the focus from three sides. On the fourth side, which is in direct contact with the surface of the skin, a process of gradual destruction of the skin takes place. At this period a feeling of pain is frequently experienced

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by the patient. The destruction of the upper layers of the skin is due to the digestive ferments liberated by the dead phagocytes.

This process leads to a gradual attenuation of the skin until it finally ruptures and the entire contents of the abscess together with the millions of phagocytes and masses of microbes are discharged. The yellowish-green pus observed in such cases represents a mixture of myriads of phagocytes and microbes.

In cases when the infective focus is far from the surface of the skin the microbes are ingested by so-called giant-cells which are formed by the fusion of phagocytes. This is an example of co-operation among the cells: the task which cannot be performed by the separate cells, the phagocytes, is relegated by the organism to groups of united cells. These giant-cells become surrounded by other cells which form around it a connective-tissue capsule.

In this way, the microbes become immured and isolated from the healthy tissues. The phenomenon described is commonly observed in tuberculosis of man and animals. It assists the organism considerably in its struggle against the tubercle bacilli and frequently results in its complete recovery. These processes have also been studied by us in insects, in which phagocytes are present and the formation of capsules and abscesses are observed.

Recently there have appeared a series of remarkable investigations, by Prof. BEZREDKA, dealing with local immunity and the rôle of the skin in immunity.

BEZREDKA has demonstrated the importance of the skin and its protective properties not only in natural immunity, but in acquired immunity as well. Guinea-pigs on which his work was conducted are extremely susceptible to the microbes of anthrax. All attempts to immunize or vaccinate these animals by means of PASTEUR'S attenuated cultures failed. Taking into consideration the fact that the skin is especially sensitive to anthrax cultures BEZREDKA attempted to vaccinate guinea-pigs by rubbing the vaccine into the skin. From the very first experiments it became evident that such vaccination was quite practicable and resulted in the production of a lasting immunity, not only of the skin, but extending to the whole organism.

More striking results were obtained with staphylococci and streptococci which are responsible for furuncles or boils and various inflammatory processes in the skin and inner organs of man.

BEZREDKA'S experiments have shown that the injection of staphylococcus vaccine into the skin, and even rubbing or moistening the skin with the vaccine gave rise to immunity in an extraordinary short time. On the other hand, subcutaneous or intraperitoneal injection failed to produce any lasting immunity. In the course of these experiments no antibodies were observed. Similar experiments were carried out with streptococci. Cutaneous immunization against these dangerous microbes proved to be as easy as in the case of staphylococci.

Further experiments by BEZREDKA demonstrated that the immunization was quite successful not only with vaccines (i.e. cultures of microbes heated to 55°C.), but also when filtrates of these cultures, deprived of the microbes, were employed. These filtrates were named 'antiviruses'. At present the application of BEZREDKA'S antiviruses is widely employed for various diseases with remarkable results.

All these facts show that the skin plays a very essential rôle not only in the defence of the organism against various infectious diseases, but also in the establishment of a lasting acquired immunity.

It is thus seen that the skin is an organ of extraordinary complexity. It respire and excretes the noxious products of metabolism, i.e. it relieves the lungs and kidneys of part of their work. Then the skin regulates the temperature of the body. It is furthermore supplied with sensory nerve endings which evoke in it the sensation of cold, heat and pain and thus regulate the activity of the entire organism through the central nervous system.

The skin is one of the most necessary and active organs of protection against all kinds of parasites and microbes all of which are constantly trying to penetrate into the organism.

The extreme importance of the skin is also due to the fact that it is the site through which vaccination is effected, i.e. the protection of the organism against various dangerous diseases. It is thus obvious that it is necessary to maintain the skin in an active state, not allowing it to decline or degenerate.

The life of the cultured man, living in towns, is, however, usually associated with an atrophy of the skin.

It has been known, since the time of the great French biologist, LAMARCK, that use causes every organ to become stronger and more vigorous, while absence of exercise and activity render it inefficient and brings about its atrophy.

By living in warm dwellings and covering ourselves with clothing we condemn our skin to constant inactivity. In the course of time, especially in elderly people, the skin gradually falls into complete decay and ceases to react with the power and energy characteristic of the skin of a young organism.

Not only the skin itself, but the entire organism, and especially our vascular system, suffer from this. As is known, the skin contains an enormous network of large and small blood-vessels which bring nutrition to the skin. Under the influence of inactivity the walls of the vessels lose their elasticity and power to react against external stimuli. This condition leads to premature sclerosis of the vessels and causes the diseases of the heart which are so prevalent among members of the professional classes.

Since the skin is so closely connected with health special attention should be devoted to the maintenance of its activity. This can be attained by artificial means, i.e. by *special exercises for the skin*.

During the warm part of the year it is necessary to have air and sun baths,

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to wear very light garments, and occasionally bathing-costumes. It is advisable to walk and perform some work in the open air, for every kind of physical exercise causes the excretion of sweat and stimulates the activity of all the cells of the skin. During the cold time of the year various artificial methods for promoting the function of the skin should be used. It is, first of all, recommended to massage the skin every morning with a rough glove, after which it is useful to rub it with cool water. Ordinary baths, shower baths or Russian baths are all efficacious in increasing the activity of the skin. They, moreover, cleanse the skin by removing from its surface the grease and dirt which plug up the openings of the sweat glands. Of equal importance are walks, games and physical exercises.

All these measures, by reinforcing the protective functions of the skin, assist in the preservation of health and in the prolongation of human life.