The thymus is essential to the maturation of the immune system. It contributes to the development of T lymphocytes, guard cells that participate in the immunoreactions. Unfortunately the thymus atrophies with age and the production of defense cells gradually declines, making human beings more vulnerable to various diseases.

Thymus: An Essential Gland of the Immune System

The thymus is essential to the maturation and maintenance of the cells of the immune system. It exerts its influence by liberating hormonal factors that act inside the thymus itself as well as elsewhere in the body. Blood concentrations of these thymic factors reach their maximal value at puberty and gradually decline afterwards. Immune system deficiencies observed in elderly people and in several diseases are linked in good part to the abnormally low level of thymic factors.

The immune system’s function is to protect the body against parasitic infections (viruses, bacteria, fungi, microbes, etc.) that cause invasive and sometimes fatal diseases. The immune system uses, among other things, the lymphocytes. Many types of lymphocytes participate in the immune response (Figure 1). For example, during a parasitic infection, the lymphocytes, called macrophages, phagocytize the parasites and break them up into fragments which are then exposed at the surface of the said macrophage and presented to the immunoregulator T lymphocytes. Those T lymphocytes activate and release messenger substances (cytokines) that increase the immune response and stimulate the production of antibodies by B lymphocytes. Other types of T lymphocytes have a direct cytotoxic action on cells presenting parasite fragments, thus completing the immune response.

At birth the child benefits from the lymphocytes passed on to him by his mother, which protect him from infections. He must quickly start to produce his own lymphocytes, which will mostly originate from bone marrow and thymus. A thymic deficiency in the newborn will result in lack of T lymphocytes and in the quick appearance of physiological complications that will translate into slowed growth rate or repetitive infections and possibly lead to premature death.

Maturation of T Lymphocytes: An Important Event in the Immune Response

The maturation and proliferation of T lymphocytes are regulated by factors produced and released by the thymus and the lymphocytes themselves. A large number of distinct factors are necessary to maintain a balanced production between the various types of T lymphocytes. These factors include almost all interleukins, thymosins, thymopoietin, thymic humoral factor, thymic factor X, serum thymic factor, as well as other thymic factors not as well characterized. These serum factors have a direct effect on the maturation and differentiation of the various types of T lymphocytes.

The lymphocytes of the thymus are multipotential cells, which means they can undergo several differentiation pathways to ultimately become functional T lymphocytes (Figure 2). Those T lymphocytes include the effector (cytotoxic cells) and immunoregulator lymphocytes (auxiliary cells, suppressive cells). When a T lymphocyte is activated by a parasite, it commits itself and becomes specific to this parasite, which will thereafter be the only activator of this sensitized lymphocyte. The committed T lymphocyte stays vigilant for the rest of its life: its survival depends on the presence of thymic factors. In a way, the committed T lymphocytes constitute a major constituent of the immune memory, allowing the body to quickly react when exposed again to the parasite.
Involution of the Thymus
During Aging and Sensitivity to Infections

The thymic gland is located at the base of the neck. In humans it continues to develop after birth and reaches its maximal size at puberty (approximately 60 g). Both lobes of the thymus are divided into lobules, which contain a cortex and a medulla. The cortex is composed essentially of lymphocytes that are the actual defense cells, while the medulla is mostly made of epithelial cells with a few scattered lymphocytes. The epithelial cells of the thymus produce most of the thymic factors necessary for the maturation and maintenance of the immune cells.

During aging the thymus gradually decreases in size and activity (Figure 3). Its weight decreases by two-thirds and its lymphocyte content by 90 percent. Cell death occurring in the tissue is not caused by the disappearance of any essential substance; in fact, this involutional phase is still not well understood and it is believed to be a natural, genetically programmed phenomenon.

The serum concentrations of thymic hormones also decrease after puberty and reach their lowest value at age 60 and on. This decrease clearly shows the deterioration of the immune system's competence observed in the elderly.

Conclusion

The thymus is an essential organ of the immune system. In the adult its functions are to produce mature lymphocytes and to maintain the health of the surveillance lymphocytes that circulate in the body and stay alert in order to quickly defend the body against a parasitic intrusion. Thymic factor deficiencies caused by illness or aging are responsible for several immune system deficiencies. Infections are then more difficult to fight and they gradually drain the vital energy of the infected individual.

Glossary

Phagocyte (n).
To engulf a microbe in order to digest it.

Gonocyte
That which destroys the cell.

References

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