

Chapter 2

The Immune System

The immune system is mentioned quite often in this book and in many others about health, so for non-medical readers, here is a very simplified description.

The body is constantly invaded by 'foreign' substances. The immune system is the protective mechanism which prevents damage to the body by invaders. Any thing which is 'non-self' is recognised as foreign, and is normally disposed of or made harmless by a healthy immune system.

The invader may be:

- Microbes - viruses, bacteriae, yeasts,
- Parasites - worms, malaria, amoeba, giardia, etc.
- Foreign tissues - e.g. transplants
- Poisons - this includes alcohol, drugs, chemical additives in food, air and water, smoke, as well as other poisons
- Cancer cells
- Dust, pollens, moulds.

It is the defensive reaction against a potentially harmful thing that produces symptoms. For example, the pain of a boil is not caused by the germs in it, but results from the swelling and increased blood flow to the area. If there was not this local painful reaction, the infection would not be sealed off and attacked, but could spread throughout the body, with serious results. Similarly, the fever and malaise that are features of the common cold are not caused by the virus, but by the chemicals produced by the immune system doing battle with the virus. In fact people whose immune system is not efficient may not have much of a fever when they have an infection.

The army the body has for its defence consists of white blood cells with different divisions, and their weapons, i.e. the substances made by white cells which help them deal with the invaders.

The white blood cells are made in the bone marrow. They are much less numerous than red blood cells (red blood cells carry oxygen round the body), but are essential to life.

The types of white blood cell are:

1. Polymorphs - their name means 'changing shape' also called granulocytes, because they contain granules which release chemicals which are poisonous to microbes. They are relatively large, and their main job is scavenging. They are highly mobile, and rush in large numbers to the site of an injury or an infection. They can engulf a bacterium by changing shape, and once inside produce chemicals which digest the germ. They are found in large numbers in pus.

2. Macrophages - large scavengers of dead tissue and foreign particles, also involved in immune reactions to destroy cells. They can produce inflammatory chemicals that cause pain, swelling, and redness in tissues. Many microbial infections that do not respond to conventional antibiotics involve microbial infestation of macrophages - e.g. tuberculosis - in which cases the infected macrophages release chemicals that can destroy surrounding tissue. Macrophages, after ingesting a foreign particle (such as a virus) can also activate T-cells.

3. Lymphocytes - two main kinds:

B lymphocytes, matured in the Bursal or lymph tissues, and

T lymphocytes, matured in the Thymus gland.

These are also called T-cells and B-cells.

B Lymphocytes

B lymphocytes produce *antibodies* (immunoglobulins) to microbes and to their toxins. An antibody is specific for the antigen - *antigen* means the thing which has stimulated the lymphocyte to make an antibody. A second exposure to the antigen induces a greater production of antibody to it, because the recipe for that particular antibody is stored on the surface of 'memory' cells - another function of white cells - and on recognition of the antigen, the B lymphocytes are stimulated to make the antibody.

This is how immunization works, and also why one becomes immune to certain diseases - e.g. measles - after one attack. These antibodies, or Immunoglobulins, are very large molecules of protein and are classified into groups, called IgA, IgM, IgG, and IgE, and then into subclasses, e.g. IgG3 - which is thought to play a major role in virus neutralization.

T Lymphocytes

There are also further subdivisions of T lymphocytes, or T-cells. There are *helper* cells, which help the B lymphocytes to produce antibodies and the polymorphs and macrophages to kill or engulf foreign matter. And when a battle with some invader is over, the *suppressor* cells stop the reaction. T-cells are given numbers; more are being discovered each year - e.g. CD4, CD8, CD56.

There are also *natural killer* - NK - cells, which destroy infected cells.

T-cells produce various chemicals called *cytokines* (or lymphokines). Names of cytokines include interferon, interleukin 1, and interleukin 2. They help in the task of killing infected cells, and a raised level in the blood suggests an ongoing viral infection. Cytokines also control the synthesis of immunoglobulins by the B-cells. Cytokines cause inflammation, and are involved in allergic responses; they are responsible for the unpleasant symptoms of influenza - fever, aching, headache, shivering, weepiness.

All white blood cells circulate in the blood and in all tissues of the body, on patrol for invaders, and can move to where they are needed.

The T lymphocytes are active against viruses, as well as helping B-cells with their work. Viruses can only survive and replicate inside living cells, so T-cells have to be able to kill the cells invaded by the virus.

Anything that

- a) reduces the number of white cells
- b) reduces their mobility
- c) weakens their killing ability

will weaken the body's defence against a viral infection.

In some interactions between antigen (a foreign agent) and the immune system, antigen-antibody 'immune complexes' are formed. In this and some other reactions, certain proteins called *complements* are used up. Other proteins may become greater in amount, e.g. C-reactive proteins. I mention this because such names come up in accounts of immunology research in M.E.

The study of immunology is relatively new in medical science; I doubt that many doctors other than immunologists really understand the immune system in depth. The above is a *very* simplified overview, and I have not attempted any proper descriptions of how the lymphocytes and cytokines work.