Viruses

Tiny, unrelenting, powerful and sometimes lethal. Viruses have a long-standing history on this planet. They come in a wide variety of shapes and sizes and can cause innumerable diseases from the benign cold to the more obnoxious and threatening—polio, hepatitis, rubella, measles, mononucleosis, mumps, yellow fever, chicken pox, herpes, and of course, AIDS.

Often difficult to trace, viruses are anywhere from ten to one hundred times smaller than a typical bacterium.

Due to the nature of their assault on the immune system, viruses are giving medicine a formidable challenge to finding effective safe cures for the diseases they cause. The failure of researchers to find a cure for the common cold is testimony to the persistent puzzle of viruses, although in the last ten years scientific understanding of these minute villains has increased significantly.

The 'modus operandi' of viruses is to attack a particular cell type, one which matches precisely to its shape and biological plan. Hepatitis B virus attacks the liver cells, whereas the polio virus journeys to the nerve cells in the spinal cord. What determines this inexorable migration is yet unknown.

Viruses are basically very simple in structure, so simple in fact they can hardly be called 'living' things. They consist of a strand of genes wrapped in an envelope of protein. By themselves they are rather useless, lacking the capability to reproduce. Without a host cell the parasitic virus cannot live and most die quickly unless they find their way into a living organism.

The AIDS virus is particularly diabolical because its target is the T-cell, the immune system's commander-in-chief which normally directs the army of defender cells in the on-going battle against infections of all kinds.

It helps our understanding of viruses and the immune system to think of them as armies in combat, with the body as the battlefield.

The immune system in a healthy person is itself highly sophisticated, formidable and reliable. Using several levels of defense, it is an army that never sleeps.

First there are the macrophages, the frontline defenders which swallow up debris in the bloodstream and alert the T-cells when a foreign invader (such as a virus) is detected.

The T-helper cells identify the invader, travel to the spleen and lymph nodes and direct the production of other cells to assist in the combat. Next the Killer T cells are recruited for action. They have the ability to puncture the walls of the virus and disable it. If this doesn't drive back the enemy, the B cells are deployed to carry out chemical warfare against the invading swarm.

The B cells produce the antibody which is designed to target specific viruses (and other unwanted foreigners) that will either neutralize them and/or flag them so that other cells will know where to attack.

Once this counter attack is successful, suppressor T cells signal the victory and the army retreats. In the meantime special memory cells use the antibody material as a sort of mug shot of the invader, otherwise known as an antigen. This will later be used to brief the immune system on the biological characteristics of the invader should it ever return. But next time the defending army will know its enemy and be better prepared to stop it in its tracks.

The AIDS virus, however, is particularly ingenious at avoiding the defending onslaught. By attacking the vital T cells, the virus throws the immune system into disarray.

Most viruses follow a similar course. Attaching itself to the cell's surface, it proceeds to break through the cellular wall and enters the cell's cytoplasm where it unleashes its own genetic material (a blueprint for action in this case) and dictates the production of more and more of the same virus.

The invaded cell becomes a factory, a biological slave, to the virus. What sets the AIDS virus apart is its capability to coerce otherwise reliable cells.

Most viruses carry DNA (deoxyribonucleic acid) the master molecule of all life. The AIDS virus, by contrast, uses RNA (ribonucleic acid) a less complete version of DNA. The AIDS virus RNA uses a special enzyme which actually alters the DNA of the invaded cell, a process referred to as 'reverse transcriptase', and this is what gives it the name retrovirus.

By slipping its RNA into the DNA of the cell, the AIDS virus manages to take over the cell machinery totally. Taking the military analogy a step further, the invading army has not only fought through the front lines of the defence, it has seized the commanders of the immune system at the highest level and 'brain washed' them into becoming dupes of the enemy. It is a thorough and most remarkable biological coup.

With most viral attacks, the immune system is only temporarily stunned and apparently helpless—though not for long. Biologically brilliant and adaptive, it sizes up the invader and sets out to destroy it. If it has had previous confrontations with the virus, all the more quickly it can engage in the counter-attack.

However, the AIDS virus has another trick up its sleeve. It has the ability to hide out in the nucleus of a cell for long periods of time without being detected. When it finally does decide to trigger the attack, the immune system is already at a disadvantge.

In this scenario, the immune system hasn't had time to recover before other forms of infection, viral and bacterial, have entered the fray. Compromised and outnumbered, the body can no longer do the job it was designed for, including defending itself against the advances of the many other infections and tumors that are normally kept in check and eventually defeated.