h. Specific immunity and innate immunity

Immune response takes two forms, namely, specific immunity and innate immunity. Specific immunity is mounted against certain specific antigens, such as protein expressed by the tuberculosis bacterium (94) in the case of immune response against tuberculosis infections, against a tumor antigen, such as mesothelin (95) in the case of immune response against pancreatic cancer, or against myelin proteins, in the case of multiple sclerosis (96). In contrast, innate immunity is stimulated by certain molecules, or more accurately classes of molecules, that are shared by many bacteria or shared by many viruses. These molecules include bacterial lipopolysaccharide, bacterial peptidoglycan, and viral nucleic acids. Each of these molecules, or more accurately classes of molecules, binds to a protein of the immune system called toll-like receptor (TLR) (97). TLRs are expressed by dendritic cells, neutrophils, and other cells of the immune system.

The importance of specific immunity is self-evident to any person familiar with vaccines. However, what is less well known to the public is that efficient specific immune response often requires simultaneous stimulation of the innate immune system. In the case of bacterial infections, where a vaccine is administered the bacterial infection generates its own innate immune response (there is no need for the physician to administer a drug that stimulates innate immune response). But in the case of vaccines against cancer, or drugs that are intended to stimulate immune response against cancer, the physician may need to administer a drug that stimulates innate immunity. These types of drugs, which may be administered with chemotherapy or a vaccine, against infections or cancer, are called *immune adjuvants*. Immune adjuvants include CpG-oligonucleotides, imiquimod, and bacillus Calmette-Guerin (BCG). BCG is used for treating bladder cancer (98).

VIII. CONCLUSIONS

Most drugs have a relatively simple mechanism of action. For example, warfarin prevents formation of mature blood clotting proteins. Aspirin inhibits cyclooxygenase. Furosemide inhibits an ion transporter. Cisplatin cross-links the DNA of the chromosome. All of these mechanisms of action can be demonstrated by in vitro techniques using cultured cells, in essence, by an experiment involving a test tube.

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