Host-Parasite Interactions

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Parasitism is a type of symbiotic relationship between two organisms: a parasite, usually the smaller of the two, and a host, upon which the parasite is physiologically dependent.

Due to close the association, the responsive reactions and resistance displayed by a host to its parasite and the protective devices adopted by a parasite in response to its host's reactions in order to establish them in their respective environments are called host-parasite-interactions.

- The host and parasite are in dynamic interaction, the outcome of which depends upon the properties of the parasite and of the host.
- The parasite has its determinants of virulence that allow it to invade and damage the host and to resist the defenses of the host.
- The host has various degrees of resistance to the parasite in the form of the host defenses.

The Host Defense

- A healthy animal can defend itself against pathogens at different stages in the infectious disease process.
- The host defenses may be of such a degree that infection can be prevented entirely.
- Or, if an infection does occur, the defenses may stop the process before the disease is apparent.
- At other times, the defenses that are necessary to defeat a pathogen may not be effective until an infectious disease is well into progress.

Defense Mechanisms

- Immune defense against pathogenic organisms is tailored to meet the broad range of their extracellular and intracellular lifecycles within the host environment.
- Defense against bacterial agents primarily utilizes antibodies, antibodies and complement, and direct cytotoxic mechanisms to control infection.
- Defense against mycobacteria requires T-cell–mediated DTH responses that result in granuloma formation. Antifungal defenses also use similar mechanisms to control organisms.
- Defense against viral agents requires antibody neutralization upon initial infection, and cytotoxic mechanisms regulated by NK cells and CTLs when expanding within cellular compartments.
- Defense against protozoal agents incorporates DTH and antibody to limit growth.
- Defense against helminths and larger multicellular organisms utilizes atopic and ADCC-dependent reactions, as well as granulomatous responses, to sequester and destroy deposited eggs.
- Organisms have evolved multiple mechanisms to evade host responses, ranging from antigenic modulation of surface proteins to direct immunosuppressive action on specific cellular subsets.

The Parasite Interaction

Releasing the determinants of virulence :

- Parasites are able to produce disease because they possess certain structural or biochemical or genetic traits that render them pathogenic or virulent.
- The sum of the characteristics that allow a given bacterium to produce disease are the pathogen's determinants of virulence.
- Some pathogens may rely on a single determinant of virulence, such as toxin production while others maintain a large repertoire of virulence determinants and consequently are able to produce a more complete range of diseases that affect different tissues in their host.

Avoiding Host Defences

- In the ongoing evolution of host-parasite relationships between humans and their infections, infectious organisms have developed ingenious ways to avoid immune defense mechanisms.
- Virtually all classes of infectious agents have devised ways to avoid host defenses.
- Organisms may locate in niches (privileged sites) not accessible to immune effector mechanisms (protective niche) or hide by acquiring host molecules (masking). They may change their surface antigens (antigenic modulation), hide within cells, and produce factors that inhibit the immune response (immunosuppression) or fool the immune system into responding with an ineffective effector mechanism (immune deviation).
- Also, bacteria have evolved to evade different aspects of phagocyte-mediated killing.

  For example, they may

- Secrete toxins to inhibit chemotaxis
- Contain outer capsules that block attachment
- Block intracellular fusion with lysosomal compartments, and
- Escape from the phagosome to multiply in the cytoplasm.
- Viral entities also subvert immune responses, usually through the presence of virally encoded proteins.
- Some of these proteins block effector functions of antibody binding, block complement-mediated pathways, inhibit activation of infected cells, and can downregulate major histocompatibility complex class I antigens to escape CTL killing.

The Result of Interaction

- In case the host defenses are of an effective degree, it can overcome the parasite and that the infection can be prevented entirely.
- Or, if an infection does occur, the defenses may well stop the process before the disease is apparent.
- At other times, the defenses that are necessary to defeat a pathogen may not be effective until an infectious disease is well into progress.
- However, the ultimate endpoint of coevolution of the human host and its infectious organisms results in an eventual mutual coexistence with most environmental organisms.
- No better evidence is the loss of this coexistence when the immune mechanisms do not function properly. Then, organisms that do not normally cause the disease to become virulent.
- In a fully evolved, mature relationship, host and infectious agent initially coexist with limited detrimental effects.
- Thus, the ultimate evolution of the host-parasite relationship is not “cure” of infection by complete elimination of the parasite, but at least mutual coexistence without deleterious effects of the parasite on the host.
- In fact, in many human infections, the infectious agent is never fully destroyed and the disease enters a latent state, only to be reactivated when immune surveillance wanes.

VECTORS {MECHANICAL AND BIOLOGICAL} Dr. C. Chatterjee

A vector is defined as **an agent (either a human, animal or microorganism) that carries and transmits a pathogen or any other infectious agent from an infected organism to another**, either directly via the blood flow or indirectly via the food, water or any other element a susceptible organism may be in contact with.

Transmission of infectious diseases may also involve a vector. Vectors may be mechanical or biological.

A mechanical vector picks up an infectious agent on the outside of its body and transmits it in a passive manner. An example of a mechanical vector is a housefly, which lands on cow dung, contaminating its appendages with bacteria from the feces, and then lands on food prior to consumption. The pathogen never enters the body of the fly. Culex mosquitos (Culex quinquefasciatus shown) are biological vectors that transmit West Nile Virus.

Biological vectors harbor pathogens within their bodies and deliver pathogens to new hosts in an active manner, usually a bite. Biological vectors are often responsible for serious blood-borne diseases, such as malaria, viral encephalitis, Chagas disease, Lyme disease and African sleeping sickness. Biological vectors are usually, though not exclusively, arthropods, such as mosquitoes, ticks, fleas and lice. Vectors are often required in the life cycle of a pathogen. A common strategy used to control vector borne infectious diseases is to interrupt the life cycle of a pathogen by killing the vector.