M220 Lecture 31

The anamnestic or memory response is one of increased magnitude and duration and is produced when an antigenic challenge is repeated for the second time. Additional challenges would further increase magnitude and duration.

See classes of antibodies handout

The T lymphocytes (T cells) are involved in cell mediated immunity. The T cells can produce lymphokines (cytokines) which are chemicals that support the entire immune response.

See T lymphocytes handout

Interferon-a group of cytokines. Some types (alpha and beta) are produced as antiviral proteins. Gamma (γ) interferon stimulates macrophage activity. The antiviral interferon is produced by cells that are under viral attack. Interferon will travel to adjacent cells that have not yet been attacked and will serve to prevent synthesis of viral proteins and nucleic acids. These cells are not only protected from the current virus but for the moment are protected against all viruses. Interferon is species specific, only human interferon can be used in humans. Interferon generally has a shorter half life than antibodies. This protein will only remain for a few weeks at most. This is an area of active research and development.

Types of antigen/antibody reactions

1. Agglutination-antibodies can cause clumping or agglutination by binding to the antigens on the surface of erythrocytes (RBCs). This kind of antigen/antibody reaction is used to type blood.

2. Precipitin reaction-in this reaction, soluble antigen can complex with antibodies and cause antigen/antibody complexes to come out of solution as a precipitate.

3. Opsonization-antibodies will stick to and coat antigens. This process enhances phagocytosis.

4. Complement activation-complement is a group of over 30 serum proteins involved in phagocytosis (can act as an opsonin) lysis of bacteria and the stimulation of the inflammatory process. This system is named accordingly because it helps or complements immune reactions. The various complement proteins are produce by cascade of events, where production of one of the proteins produces the next. In the classical pathway of complement activation, antibodies attaching to antigens initiate this system.

5. Neutralization-antibodies can coat the outside of a virus (antigenic) and prevent that virus from attachment and replication, thus neutralizing it. Antibodies can also adhere to and coat toxins that are in circulation rendering those toxins inactive and thus neutralizing them.
Vaccines

1. "Live" and attenuated-provides for longer immunity, usually without the need for booster shots. However, the possibility exists that the live bacterial organism or "live" virus might mutate to a virulent form.
   a. Sabin (oral) vaccine for polio
   b. Yellow fever vaccine
   c. Rubella vaccine (German measles)
   d. Rubeola vaccine (measles)
   e. Mumps vaccine

   The combined vaccine called MMR stands for measles, mumps and rubella.

   An attenuated preparation of the bacterial organism *Mycobacterium bovis* is used as a vaccine against tuberculosis. The vaccine is referred to as the BCG vaccine which stands for bacillus of Clamette and Guerin. Common antigens on this organism and *M. tuberculosis* will provide for an appropriate immune response if challenged by *M. tuberculosis* bacteria. A positive tuberculin skin test may result from having received this vaccine as antibodies are present. This vaccine is used outside of the U.S.

2. "Dead" (killed) infectious agents-this process usually makes use of formalin (formaldehyde) or other chemicals to achieve the killing. One does not have to worry about the possibility of an infectious agent mutating if the infectious agent truly has been inactivated. However, the immunity from these vaccines is not as strong or as long-lasting as from the attenuated vaccines. Booster shots may be required.
   a. Rabies vaccine
   b. Influenza vaccine
   c. Salk (injection) vaccine for polio
   d. Typhus vaccine
   e. Typhoid fever vaccine
   f. Cholera vaccine
   g. Original vaccine for whooping cough (pertussis)-contained higher levels of endotoxin than other vaccines and may produce feverish and allergic side reactions. The organism that causes this disease is called *Bordetella pertussis*. This is an aerobic Gram negative rod. A newer acellular vaccine uses selected antigens (parts) in the form of toxoids to induce immunity and causes fewer side-effects.

3. Part of organism or infectious agent-uses structural or secreted components from infectious agents to create vaccines. Recombinant DNA technology and genetic engineering has allowed for the production of pure antigen product for vaccines. A newer vaccine for Hepatitis B makes use of capsid proteins. Secreted exotoxins can be heat treated to create toxoids for vaccines. As previously mentioned the newer acellular pertussis vaccine uses toxoids.

   The DPT vaccine is a combined vaccine for diphtheria, pertussis and tetanus. Toxoids are used for diphtheria and tetanus. The original DPT vaccine contained killed pertussis bacteria. The newer DTaP vaccine contains the acellular pertussis vaccine which uses toxoids and not the killed cells. Remember toxoids are made from exotoxins which can be elaborated from both Gram negative and Gram positive bacteria. Endotoxins are found exclusively in the cell walls of Gram negative bacteria and cannot be made into toxoids.