MEDICAL UNIVERSITY – PLEVEN
FACULTY OF MEDICINE

DEPARTMENT OF INFECTIOUS DISEASE, EPIDEMIOLOGY, PARASITOLOGY AND TROPICAL MEDICINE

Lecture № 3

SIXTH YEAR MEDICAL STUDENTS - TRAINEE DOCTORS

SPECIFIC PROFILAXIS. NATIONAL IMMUNIZATION SCHEDULE.

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Host difences

- **Host defenses** against infection are at once local and systemic, non – specific and specific, and humoral and cellular.
- The concept of overlapping host defenses is crucial to our understanding of susceptibility to infection.

Specific defenses

- Specific defenses come into play, once microorganisms have breached local defense mechanisms.
- By virtue of this defenses, the host is able to recognize, destroy and eliminate antigenic material /e.g. bacteria, viruses, proteins, etc./ foreign to his own.

Active Immunity

- In other words, active immunity depends upon the humoral and cellular responses of the host. The immunity produced is specific for a particular disease, i.e., the individual in most cases is immune to further infection with the same organisms or antigenically related organism for varying periods depending upon the particular disease.

Active immunity may be acquired in 3 ways:

- Following clinical infection – chickenpox, rubella, measles…
- Following subclinical or unapparent infection – polio, diphtheria…
- Following immunization with an antigen which may be a killed vaccine, a live attenuated vaccine or toxoid.

Active Immunity

- Active immunity takes time to develop. It is superior a passive immunity because the duration of protection, like that of the natural infection is frequently long – lasting with few exceptions, severe reactions are rare the protective efficacy of active immunization exceeds that if passive immunization, and active immunization is less expensive than passive immunization.

Passive Immunity

- When antibodies produced in one body (human and animal) are transferred to another to induce protection against disease, it is known as passive immunity. In other words, the body not produce its own antibodies but depends upon ready – made antibodies.

Passive immunity may be induced:

- by administration of an antibody – containing preparation (immune globulin or antiserum).
- by transfer of maternal antibodies across the placenta; human milk also contains protective antibodies (IgA);
- by transfer of lymphocytes, to induce passive cellular immunity – experimental procedure.

Passive immunity differs from active immunity in the following respects:

- immunity is rapidly established;
- immunity produced is only temporary (days to months) till the antibody is eliminated from the body;
- there is no education of the reticulo – endothelial system.

Herd Immunity

- It is the level of resistance of a community or group of people to a particular disease.
- According to another source herd immunity implies group protection beyond that afforded by the protection of immunized individuals.
- That is, it concerns the freedom from infection of individuals within a herd structure on the transmission among individuals.

Herd Immunity

- Herd immunity provides an immunological barrier to the spread of disease in the human herd.
- For example, when an infectious diseases is introduced into a “virgin” population, that is population with a very low or no immunity, the attack and case fatality rates tend to be very high involving practically all susceptible as it had happened in the very severe measles epidemic in the Faroe island, in 1854, where the population had no previous experience of measles.
- The epidemic wave declined with a build – up of herd immunity following natural infection.

Elements which contribute to herd immunity are

- occurrence of clinical and subclinical infection in the herd;
- immunization of the herd;
- herd structure.

Herd structure

- Herd structure is never constant. It is subject to constant variation because of a new births, deaths and population mobility.
- An on – going immunization programme will keep up the herd immunity at a very high level.

Immunizing agents

- vaccines
- immunoglobulins
- antisera

Vaccines

- Vaccine is an immuno-biological substance designed to produce specific protection against a given infectious disease. It stimulate the production of protective antibody and other immune mechanisms.

Classification of Vaccines

I Live attenuated

- Viral – Polio (oral), Yellow fever, Measles, Rubella, Mumps, Influenza: intranasal, Vaccinia, Varicella, Zoster, Rotavirus
- Bacterial – BCG, Typhoid (oral), Plague
- Rickettsial

II Inactivated

- Viral – Rabies, Hepatitis A, Polio (Salk), Influenza, CCHF
- Bacterial – Typhoid, Cholera, Pertussis, Plague

III Recombinant – Hepatitis B, Lymerix

Live attenuated vaccines

- To produce an immune response, live vaccines must replicate (grow) in the vaccinated person. A relatively small dose of virus or bacteria is administered, which replicates in the body and creates enough of the organism to stimulate an immune response. Anything that either damages the live organism in the vial (e.g., heat, light) or interferes with replication of the organism in the body (circulating antibody) can cause the vaccine to be ineffective.

Live attenuated vaccines

- Although live attenuated vaccines replicate, they usually do not cause disease such as may occur with the “wild” form of the organism. When a live attenuated vaccine does cause “disease”, it is usually much milder than the natural disease and is referred to as an adverse reaction.

Live attenuated vaccines

- The immune response to a live vaccine is virtually identical to that produced by a natural infection. The immune system does not differentiate between an infection with a weakened vaccine virus and an infection with a wild virus. Live vaccines are usually effective with one dose, except those administered orally.

Live attenuated vaccines

- Live attenuated vaccines may cause severe or fatal reactions as a result of uncontrolled replication (growth) of the vaccine virus. This only occurs in person with immunodeficiency (e.g. leukemia, lymphoma or malignancy, treatment with certain drugs, radiation or HIV infection). Pregnancy is another contraindication unless the risk of infection exceeds the risk of harm to the fetus of some live vaccines.

Live attenuated vaccines

- Active immunity from a live attenuated vaccine may not develop because of interference from circulating antibody to the vaccine virus. Antibody from any source (e.g., transplacental, transfusion) can interfere with replication of the vaccine organism and lead to poor response or no response to the vaccine (also known as vaccine failure).

Inactivated vaccines

- Inactivated vaccines are produced by growing the bacterium or virus in culture medium, then inactivating it with heat and/or chemicals (usually formalin). In the case of fractional vaccines, the organism is further treated to purify only those components to be included in the vaccine (e.g. the polysaccharide capsule of pneumococcus).

Classification

- Whole – cell vaccines

1. Viral – Polio, Hepatitis A, Rabies, Influenza
2. Bacterial – Pertussis, Typhoid, Cholera, Plague

- Fractional vaccines

1. Protein – based
   - Toxoid – Diphtheria, Tetanus
   - Subunit – Hepatitis B, Influenza, Pertussis (acellular), Human papillomavirus, Lyme disease
2. Polysaccharide – based
   - Pure – Pneumococcal, Meningococcal, S. typhi (Vi)
   - Conjugate – Hib, Pneumococcal, Meningococcal

Inactivated vaccines

- Inactivated vaccines are not alive and cannot replicate. The entire dose of antigen is administered in the injection (usually administered by subcutaneous or intramuscular route). These vaccines cannot cause disease from infection, even in an immunodeficient person.

Inactivated vaccines

- Inactivated antigens are less affected by circulating antibody than are live agents. Inactivated vaccines may be given when antibody is present in the blood (e.g., in infancy or following receipt of antibody – containing blood products).

Inactivated vaccines

- Inactivated vaccines always require multiple doses. In general, the first dose does not produce protective immunity, but “primes” the immune system. A protective immune response develops after the second or third dose. In contrast to live vaccines, in which the immune response closely resembles natural infection, the immune response to an inactivated vaccine is mostly humoral.

Polysaccharide vaccines

- Polysaccharide vaccines are a unique type of inactivated subunit vaccine composed of long chains of sugar molecules that make up the surface capsule of certain bacteria. Pure polysaccharide vaccines are available for three diseases: Pneumococcal disease, Meningococcal disease, and Salmonella typhi.

Polysaccharide vaccines

- The immune response to a pure polysaccharide vaccine is typically T-cell independent, which means that these vaccines are able to stimulate B cell without the assistance of T-helper cells. T- cell independent antigens, including polysaccharide vaccines, are not consistently immunogenic in children younger than 2 years of age. Young children do not respond consistently to polysaccharide antigens, probably because of immaturity of the immune system.

Polysaccharide vaccines

- Repeated doses of most inactivated protein vaccines cause the antibody titter to go progressively higher, or “boost”. This is not seen with polysaccharide antigens; repeat doses of polysaccharide vaccines do not cause a booster response. Antibody induced with polysaccharide vaccines has less functional activity than induced by protein antigens. This is because the predominant antibody produced in response to most polysaccharide vaccines is IgM, and little IgG is produced.

Recombinant Vaccines

- Vaccine antigens may also be produced by genetic engineering technology. These products are sometimes referred to as recombinant vaccines. Hepatitis B and HPV vaccines are produced by insertion of a segment of the respective viral gene into the gene of a yeast cell.

Recombinant Vaccines

- The modified yeast cell produces pure hepatitis B surface antigen or HPV capsid protein when it grows. Live typhoid vaccine (Ty21a) is Salmonella Typhi bacteria that have been genetically modified to not cause illness. Live attenuated influenza vaccine has been engineered to replicate effectively in the mucosa of the nasopharynx but not in the lungs.

Toxoids

- Certain organisms produce exotoxins, e.g., diphtheria and tetanus bacilli. The toxins produced by these organisms are detoxicated and used in the preparation of vaccines. The antibodies produced neutralize the toxic moiety produced during infection, rather than act upon the organisms. In general, toxoid preparations are highly efficacious and safe immunizing agents.

Route of administration of vaccines

- subcutaneous
- intramuscular
- intranasal
- oral

Adverse Reaction Following Vaccination

1.Local

- pain, swelling, redness at site of injection
- common with inactivated vaccines
- usually mild and self-limited

Adverse Reaction Following Vaccination

2. Systemic

- fever, malaise, headache
- nonspecific
- may be unrelated to vaccine
- Live attenuated vaccines:
- must replicate to produce immunity
- symptoms usually mild
- occur after an incubation period (usually 7-21 days)

Adverse Reaction Following Vaccination

3. Allergic
   - due to vaccine or vaccine component
   - rare
   - risk minimized by screening

C – contraindication; P – precaution;

V – vaccinate of indicated

Condition	Live	Inactivated
Allergy to component	C	C
Encephalopathy	C	C
Pregnancy	C	V
Immunosuppression	C	V
Severe illness	P	P
Recent blood product	P	V

Immunoglobulin preparations

- **Normal human Ig (NHIg)** is an antibody – rich fraction, obtained from a pool of at least 1000 donors. NHIg is used to prevent measles, hepatitis A, meningococcal infection for travelers to endemic areas and control institutional and household outbreaks. Live vaccines should not normally be given for 12 weeks after an injection of NHIg, and if a live vaccine has already been given NHIg injection should be deferred for 2 weeks.

Immunoglobulin preparations

- **Specific human Ig** (hyper immune) should contain at least 5 times the antibody potential of the standard preparation per unit volume. These preparations are made from plasma of patients who have recently recovered from an infection or are obtained from individuals who have been immunized against a specific infection. For example: HBIg, RIg, TIg…

Immunoglobulin preparations

- Immunoglobulin is administered by intramuscular injection. Immunoglobulin suitable for intravenous administration has also become available. The intramuscular injections are painful for some patients. Doses larger than 5 ml. must be divided and injected into 4 – 6 intragluteal site.

Immunoglobulin preparations

- Peak blood levels are reached in 2 days after i.m. injection. The half – life is 20 –35 days. They should not be given shortly before or after active immunization to avoid inhibiting the immune response (without HB and Tetanus immunization).

Antisera or antitoxins

- Small number of diseases are administered – tetanus, diphtheria, botulism, gas gangrene, snake bite for passive immunization. They prepared from animal sources such as horses. Administration of antisera may give rise to serum sickness and anaphylactic shock.

The Cold Chain

- The “cold chain” is a system of storage and transport of vaccines at law temperature from the manufacturer to the vaccination site. It is necessary because vaccine failure may occur due to failure to store and transport under strict temperature controls. Generally, temperature is strictly kept between 2 and 8 degrees C.