Principles of Communicable Diseases Epidemiology

LECTURE - 3

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Susceptible Host

The final link in the chain of infection is a susceptible host.

A person or animal lacking sufficient resistance to a particular pathogenic agent to prevent disease if or when exposed.

Occurrence of infection and its outcome are in part determined by host factors.

Resistance to infection is determined by non-specific and specific factors:

- **NON-SPECIFIC FACTORS**

- **Skin and mucus membrane**
- **Mucus, tears, gastric secretion**
- **Reflex responses such as coughing and sneezing.**

- **SPECIFIC FACTOR is immunity, produced by specific immune response of the body.**

The immunity is either :Naturally acquired or artificially induced immunity.

Acquired immunity may be active or passive

A- Active Immunity : it is the immunity which the individual develops as a result of :

- **Following clinical infection,**
- **Following sub-clinical infection, or**
- **Following immunization.**

B- Passive Immunity: when antibodies produced in one body [human or animal] are transferred to another to induced protection against disease.

Passive immunity may be induced :

By administration of an antibodies containing preparation [immunoglobulin], maternal antibodies across the placenta , human milk also contain protective antibodies [IgA].

Why an individual may have more than one attack of a particular infectious disease?

True second attack due to agent or host factors

- **Agent Factors**

1-Causative agent has a number of antigenic sero - types, streptococcus haemolyticus.

2-With organisms characterized by antigenic changes, shift and drift of influenza virus.

- Host Factors

1-After an attack , the acquired immunity level may decline by time , until becoming non protective.

2-When specific chemotherapy is given early in the disease , before infection stimulate efficient immune response ;enteric fever

3-in pulmonary TB and other diseases , where treated cases ,
(by specific chemotherapy) is not cured, but becomes inactive & may be exposed to reactivation under adverse predisposing conditions

4-cases having impaired or deficient immune response :
*** acquired by sever malnutrition, or under immune suppression therapy.**
***genetic agammaglobulinemia, or hypo gamma globulinemia, rarely.**

Immunization

- **Immunization: a procedure designed to increase concentrations of antibodies and/or effector T-cells which are reactive against infection (or cancer).**
- **Immunization procedure called vaccination and the immunizing agent called vaccine.**

IMMUNIZING AGENTS

The immunizing agents may be classified as vaccine, immunoglobulin and antisera.

Vaccines

A vaccine is a biological preparation that improves immunity to a particular disease .

A vaccine typically contain an agent that resembles a disease –causing microorganism , and is often made from weakened or killed forms of the microbe or its toxins.

The agent stimulates the body's immune system . Vaccines can be prophylactic or therapeutic .

There are several types of vaccines currently in use .

These represents different strategies used to try to reduce risk of illness .

TYPES OF VACCINES

1-LIVE VACCINE:

Only small pox vaccine is no more in uses at present.

2- LIVE ATTENUATED VACCINE:

a virulent vaccine, virulent pathogenic organisms can not be used as such, but so treated to become attenuated and a virulent, but remain antigenic.

Available live attenuated vaccines are:

BCG **Use for prevention of TB**

OPV (oral polio vaccine) (Sabin)

- OPV live attenuated , 2 drops

Measles

MMR(measles, mumps, rubella)

Rubella

- 0.5 ml
- Subcutaneous -arm

Rotavirus vaccine

A rotavirus vaccine protects children from rotaviruses, which are the leading cause of severe diarrhea among infants and young children.

Rota virus vaccine is a live, oral pentavalent vaccine that contains five rotaviruses.

In general, live attenuated vaccines are more potent immunizing agents than killed vaccines, the reasons being :

(I) live organisms multiply in the host and the resulting antigenic dose is larger than what is injected.

(ii) live vaccines have all the major and minor antigenic components.

(iii) live vaccines occupy certain tissues of the body, as for example, intestinal mucosa by the oral polio vaccine.

(iv) There may be other mechanisms such as the persistence of latent virus.

Such vaccines produce a durable immunity , but not always as long as that of natural infection.

Live attenuated vaccines should not be administered to persons with immune deficiency diseases or to persons whose immune response may be suppressed because of leukemia, lymphoma or malignancy or because of therapy with corticosteroids, alkylating agents, anti - metabolic agents, or radiation.

Pregnancy is another Contraindication.

When two live vaccines are required they should be given either simultaneously at different sites or with an interval of at least 3 weeks.

In the case of live vaccines, immunization is generally achieved with a single dose.

The exception is polio vaccine which needs three or more doses to be given at spaced intervals to produce effective immunity.

3-INACTIVATED VACCINES (killed vaccine)

live attenuated vaccines can not be prepared for some infectious diseases, where killed organisms are used.

Though inactivated (by heat& chemicals), they are antigenic and stimulate immune response.

TAB (ENTERICA), Pertussis, cholera, Salk (parenteral) for polio, hepatitis A and rabies vaccine.

4-Cellular fractions: prepared from extracted cellular fractions, e.g., meningococcal vaccine from polysaccharide of the cell wall, They are available for:

meningococcal, pneumococcal, & homophiles influenza vaccine (Hib) Hepatitis B poly peptide vaccine (new).

Polysaccharide vaccine prevents disease, but cant prevent carrier state

5-SURFACE – ANTIGEN VACCINE (subunit) **: protein subunit –rather than introducing an inactivated or attenuated microorganism to immune system, a fragment of it can create an immune response.**

Examples include the subunit vaccine against *Hepatitis B virus* that is composed of only the surface proteins of the virus

***Yeast – recombinant hepatitis B vaccine; Hbs Ag needed to prepare the vaccine is produced by recombinant DNA in yeast cell, it is the vaccine used at present.**

- **Virus –like particle (VLP) vaccine against human papilloma virus (HPV) .**

TOXOIDS

They are detoxicated exotoxins preparations which stimulate formation of humoral antitoxin immunity.

Diphtheria toxoids & tetanus toxoids are widely used for active immunization, each by itself or in combinations (DPT& DT) ,Pertussis toxoids (less reaction), Cholera toxiod ;oral , against cholera exotoxin, which is the major pathogenic factor of cholera vibrios.

SCHEDUALE of ACTIVE IMMUNIZATION in IRAQ for CHILDREN 2016

Age	Vaccine
After birth	BCG, OPV (0 dose) , HBV (within 24hr)
2 Months	(السداسي)[DPT, Hib , HBV,IPV], Rota virus (1st dose)
4Months	[DPT, Hib ,IPV], Rota virus , (2ND dose)(الخماسي)
6Months	[DPT, Hib , HBV, IPV], Rota virus , (3rd dose)
9Months	Measles vaccine + vit A (100 IU)
15 Months	MMR
18 Months	[DPT , Hib], OPV (1ST booster dose)+ vit A (200IU)
4-6 Years	DPT + OPV (2ND booster dose), Measles (2nd dose)

SYSTEMS OF ACTIVE IMMUNIZATION

Primary (first time) immunization & booster immunization or revaccination, are to maintain protective immune level, if necessary.

1-Primary immunization : giving either single dose or more than one dose with proper spacing in between doses, according to nature of vaccine.

One- dose primary immunization stimulates formation of protective immunity either:

- **Producing a form of innocent infection; certain viral vaccines.**
- **Forming a focus of infection, at site of inoculation, that stimulates the immune response, and continues for so long as the focus exists, BCG.**

Single dose vaccine: **MEASLES, MUMPS, RUBELLA, MMR, BCG, PLAGUE.**

Multiple –dose primary immunization: **for efficiently protective immune response, in toxoids & certain vaccines , it is necessary to fulfill :**

- **Giving a suitable NO. Of doses, usually (3), sometimes 2, and occasionally 4, according to preparation, but for rabies vaccine more doses are given.**

- **Proper spacing of doses, varies may be 4 weeks (TAB, CHOLERA), 8weeks (DPT, OPV,). Less spacing than the optimum lowers the immune response, but longer spacing would not affect the response.**

Multiple dose vaccine/ toxoids: DPT, DT, OPV, HB VACCINE, TAB, CHOLERA VACCINE.

2. **Booster immunization as long as an individual or particular group is exposed to the risk of infection, it is necessary to give a booster dose after a suitable interval, to maintain a satisfactory level of immunity.**

Protective period of full primary & booster immunization:

- **short period of some months; cholera & plague vaccines which are protective for about 6M.**
- **3- 5 years: DPT, Tetanus toxoids**
- **5 or more years : BCG**
- **Solid, life time immunity: Measles, MMR, Mumps no booster doses are needed).**

Mixed- antigen vaccine: **some vaccines are prepared of two or more antigen, when it is necessary to give them simultaneously --- DPT, DT, MMR, they stimulate similarly not less, efficient response.**

What are the factors determining effectiveness of active immunization in prevention of a particular infectious disease in the community?

1-Vaccine or toxoids:

* **Protective (immunologic) value.**

* **How handled since prepared until used, including the cold chain.**

* **For organisms characterized by frequent antigenic changes – influenza vaccine must be prepared from the prevailing organisms of out break or epidemic.**

2-Process of immunization: requirements of primary & booster immunization, or revaccination, including doses, spacing & route of administration must be fulfilled.

3-Vaccination coverage: it is the percent of individuals of at risk group or population, who has been fully immunized. For satisfactory benefit of a given vaccine, coverage must be not less than 80- 85%.

Ways of achieving satisfactory immunization coverage

- ✓ **Well-organized immunization service; urban and rural**
- ✓ **Health awareness and cooperation of the public**
- ✓ **Periodic mass immunization campaigns, to cover those who missed regular immunizations**
- ✓ **Outreach programs in rural and refugee areas, and home visits**

Why an actively immunized individual may get disease when exposed to infection?

1-Causes related to the vaccine/ toxoids & process of immunization : inactivation of live attenuated vaccine used; not using updated vaccine of antigenic ally changing organisms, moderate protective value of vaccine

2- Host factors:

* **Unsatisfactory or impaired immune response .**

* **Serum antibody level at time of immunization; the higher the level, less immune response to active immunization & vice versa.**

What are the infectious diseases where active immunization is the only or basic, preventive measure?

Rabies, Poliomyelitis, Measles, Mumps, Rubella, Diphtheria, Tetanus, TB, Hepatitis B.