Epidemiology

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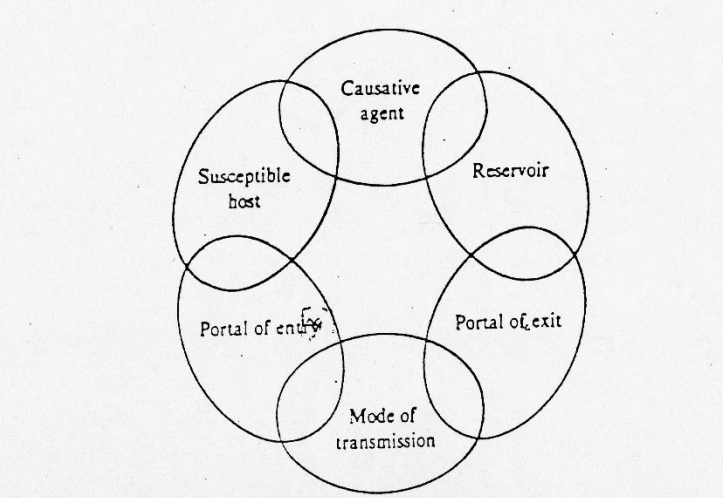

FIGURE 1.2 The chain of infection. Components of the infectious disease process.

Infectious process

SUSCEPTIBLE HOST

The Host

is a person or other living animal including birds and arthropods that **afford maintenance,** (survival) or **lodgment** to an infectious agent under natural conditions

Successful parasitism

Four stages have been described in successful parasitism

- **a)**First, the infectious agent must **find a PORTAL OF ENTRY by which it may enter the host.** There are many portals of entry, e.g., *respiratory tract, alimentary tract, genitourinary tract, skin, etc.*
  - **Some organisms may have more than one portal of entry**, *e.g., hepatitis B, Q fever, brucellosis*.
- b) **On gaining entry into the host, the organisms**
- **must reach the appropriate tissue or "SITE OF ELECTION"** (**tropism)** in the body of the host **where it may find optimum conditions for its multiplication and survival.**
- (c) Thirdly, the disease agent must find **a way out** of the body **(PORTAL OF EXIT)** in order that it **may reach a new host** and propagate its species.

- **If there is no portal of exit, the infection becomes a**
- ✓ **dead-end** infection as in *rabies, bubonic plague, tetanus and trichinosis*.
- ❖ (d) **After leaving the human body, the organism must**
- ❖ **survive** in the **external environment** for **sufficient period till a new host is found.**

- ❑ **In** addition, a **successful disease agent should not cause the death of the host but produce only a low-grade immunity so that the host is vulnerable again and again** to the same infection.

***The best example is common cold virus*.**

Incubation period

defined as: "the time interval between invasion by an infectious agent and appearance of the first sign or symptom of the disease in question" .

- **During the incubation** period, the infectious agent undergoes
- **multiplication** in the host. When a **sufficient density of the** disease agent **is built up** in the host,
- **the health equilibrium is disturbed** and
- the **disease becomes overt.**

- **Factors which determine the incubation period include:**
  - **the generation time** (time that it takes for bacteria to divide ,usually in hours or days). **of the particular pathogen,**
  - **infective dose,**
  - **portal of entry and**
  - **individual susceptibility.**
- In some, the incubation period is of **median length**

- **median length** ranging from **10 days to 3 weeks** : ***typhoid infections***, *virus diseases such as chickenpox,* ***measles and mumps***.
- **longer incubation** periods (**from weeks to months or years**) and
- whose **incubation time is difficult to measure precisely**, e.g., hepatitis A and B, rabies, leprosy and slow virus diseases.

Serial interval

- **In actual practice we seldom know precisely the incubation period of a disease**. But we know,
- **when an outbreak of disease occurs**, say in a **family which** is the smallest group and also a closed group, **there is**
- **an initial primary case**. **The primary case is followed by**
- **2 or 3 secondary cases within a short time.**

❖ **The gap in time between the onset of the primary case and the secondary case is called the "serial interval".**

By collecting

By collecting information about a whole series of such onsets, we get a distribution of secondary cases from

❖ which we can guess the incubation period of disease

- **Communicable period**

The communicable period is defined as

"the time during which an infectious agent may be transferred directly or indirectly from an infected person to another person, from an infected animal to man, or from an infected person to an animal, including arthropods"

- Communicability varies in different diseases.
- Some diseases are more communicable during the incubation period than during actual illness.
- Communicability of some diseases can be reduced by early diagnosis and treatment.
- An important measure of communicability is

Secondary attack rate.

Secondary attack rate (SAR) is defined as "the number of exposed persons developing the disease within the range of the incubation period, following exposure to the primary *case"*

HOST DEFENCES

Host defences against infection are at once

- local and systemic,
- non-specific and specific, and
- humeral and cellular.

- It is difficult to identify any infectious agent that fails to stimulate multiple host defence mechanisms

Resistance:

It is the total body mechanisms which act as barriers to invasion or multiplication of infectious agents or their damaging effects of their toxins

1) **Natural barriers** (Inherent resistance or innate immunity).
2) **Acquired resistance** (immunity).

- **Inherent resistance (Natural barriers (innate immunity):**

✓ **Non-specific resistance of the body against the invading organisms which**

✓ **doesn't depend** on the presence of **specific antibodies or antitoxin** for protection, **But depends on**

✓ **the anatomical or physiological characteristics** of the host.

1) Inherent resistance (innate immunity):

Natural defensive mechanisms:

- **The body surface**
- **Phagocytic cells lying in tissues**
- **Blood**

1)Natural barriers (Inherent innate immunity
2) Acquired resistance (immunity).

2) Acquired resistance (immunity).

i. Passive immunity:

- Natural
- Artificial

ii. Active immunity

- Natural
- Artificial

❑ Passive immunity:

Type of resistance in which ready made antibodies are gained

1. Natural passive: antibodies from the mother.
2. Artificial passive: by injecting immune serum or immunoglobulin

Acquired resistance (Immunity):
Passive immunity:
Natural
Artificial
Active immunity
Natural
Artificial

cont. .. Passive immunity :

- **Natural passive immunity: (Infant immunity)**
  - Infant resistance due to antibodies passed to the fetus through the placenta.
  - **The mother should have acquired the infection and/or vaccine & developed specific antibodies against the disease.**
  - **They are at highest level at birth** and decline gradually till **disappearance by the 6th month.**
  - **Can be induced by immunizing the mother during pregnancy by** ***tetanus toxoid to protect the infant against tetanus neonatorum*****.**

❖ **Breast milk,** specially the **colostrums** contains

- **plenty of antibodies** (about 95% of colostrums' proteins)
- Antibodies are continuously secreted in breast milk but at lower levels than the colostrums.

cont. .. Passive immunity :

Acquired resistance (immunity)
Passive immunity:
Natural
Artificial
Active immunity
Natural
Artificial

2. Artificial passive immunity:
(passive immunization or Immuno-prophylaxis)

- Immunity induced by injecting immune serum or immunoglobulin.
- Characterized by short duration (for about 3 weeks) during which the antibodies are gradually eliminated

A. Sera of artificially immunized animals

used either for prophylaxis or treatment as *anti-tetanic or antidiphtheritic sera.*

B. Immunoglobulin:

This is the plasma protein fraction that carries most of antibodies and used as prophylaxis as in hepatitis A.

Acquired(immunity).
Passive immunity:
Natural
Artificial
Active immunity
Natural
Artificial

ii. Active immunity:

Type of resistance in which the person makes or develops his own antibodies.

1. Natural active:

- post infection immunity.
- may be solid, long [mumps or measles],
- moderate [meningitis] or
- short duration [common cold])

2.Artificial active:

- post vaccination immunity,
- where the specific antigen when introduced in the
- body provoke the formation of antibodies

IDEAL IMMUNIZING AGENT:

- ✓ Minimal side effects
- ✓ Antigenic stability
- ✓ Durable immunity
- ✓ Easy administration
- ✓ Few injections
- ✓ Reasonable cost
- ✓ Availability
- ✓ Good keeping quality (long shelf life)
- ✓ Easy storage

Herd immunity

- It's the state of immunity within the community.
  - It's the factor that decides the epidemiological pattern of any infectious disease among that community.

- Herd immunity theory proposes that in diseases passed from individual to individual, it is difficult *to* maintain a chain of infection when large numbers of a population are immune.

- The higher the number of immune individuals, the lower the likelihood that a susceptible person will come in contact with an infectious agent
- Herd immunity provides an immunological barrier to the spread of disease in the human herd

Cont. .....Herd immunity

- population with a very low or no immunity, the attack and
- case fatality rates tend to be very high involving practically all susceptible
- The epidemic wave declined with a build-up of herd immunity following natural infection.
- The disease incidence rises at times when the number of susceptible in the population is highest and the herd immunity is lowest.
- Herd immunity results from
  - either an epidemic or
  - after obligatory immunization schedules

- Herd immunity may be determined by serological surveys (serological epidemiology).

Community protection is governed by:

1. The extent of coverage of the immunization program.
2. The degree of resistance to infection afforded by the vaccine.
3. Duration and degree of infectivity of the organism.
4. Past experience with different infections.
5. Overcrowding and environmental sanitation

Thank You