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ARTIFICIAL IMMUNIZATION – I

**The 12th lecture for the 2nd-year students
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Infection – revision

Definition:

Infection = a relation between the pathogenic microbe and the macroorganism (= ecological point of view)

Infection colonization:

Infection = situation when an **etiological agent**

- 1) **penetrates into an organism and multiplies in it, or**
- 2) **it settles on bodily surfaces (skin or mucosae) and unfavourably affects them**

Colonization = situation when

- 1) **a non-pathogenic microbe settles on a bodily surface, or**
- 2) **a pathogen located there does not cause pathological symptoms**

Course of infection – revision

Four components can be distinguished during the course of infection:

- **Incubation time**
- **Prodromes**
- **Typical syndrome (= complex of symptoms) of the infectious disease**
- **Convalescence**

Forms of infection – revision

Inapparent infection (without symptoms)

sole consequence: development of immunity (usually by means of antibodies)

Manifest infection (with symptoms)

subclinical: non-characteristic signs only

abortive: only some symptoms or slightly manifested ones

clinical: typical signs as in textbook

foudroyant, fulminant: very abrupt, with dramatic symptoms

Duration of infection – revision

Acute: days (common cold, salmonellosis)
to weeks (majority of infections)

Subacute: months – either as a complication of any infection, or as the rule (some kinds of hepatitis, warts, sepsis lenta)

Chronic: years (tbc, lepra, dermatomycoses, parasitic infections)

Fulminant, foudroyant: very rapid course –
hours (meningococcal sepsis)

Extent of infection – revision

Local: portal of entry & regional nodes, or a specific organ (common cold, ringworm, warts, uncomplicated gonorrhoea, abscessus in an organ)

Systemic: whole organ system (influenza, lung tbc, meningitis, extensive pyoderma, pyelonephritis, pelvic inflammatory disease)

Generalized: **regularly** (exanthematic viroses, typhoid fever, exanthematic typhus), **or as a complication** (sepsis after injury, during cystitis or cholecystitis, salmonellosis in a newborn)

Other types of infection – revision

Opportunist infection: infection on a weakened terrain, often secondary one

During **AIDS**: CMV retinitis, CMV or candidal esophagitis, herpes zoster, cryptococcal meningitis, toxoplasmatic encephalitis, cryptosporidial or microsporidial enteritis, colibacillary and other types of sepsis

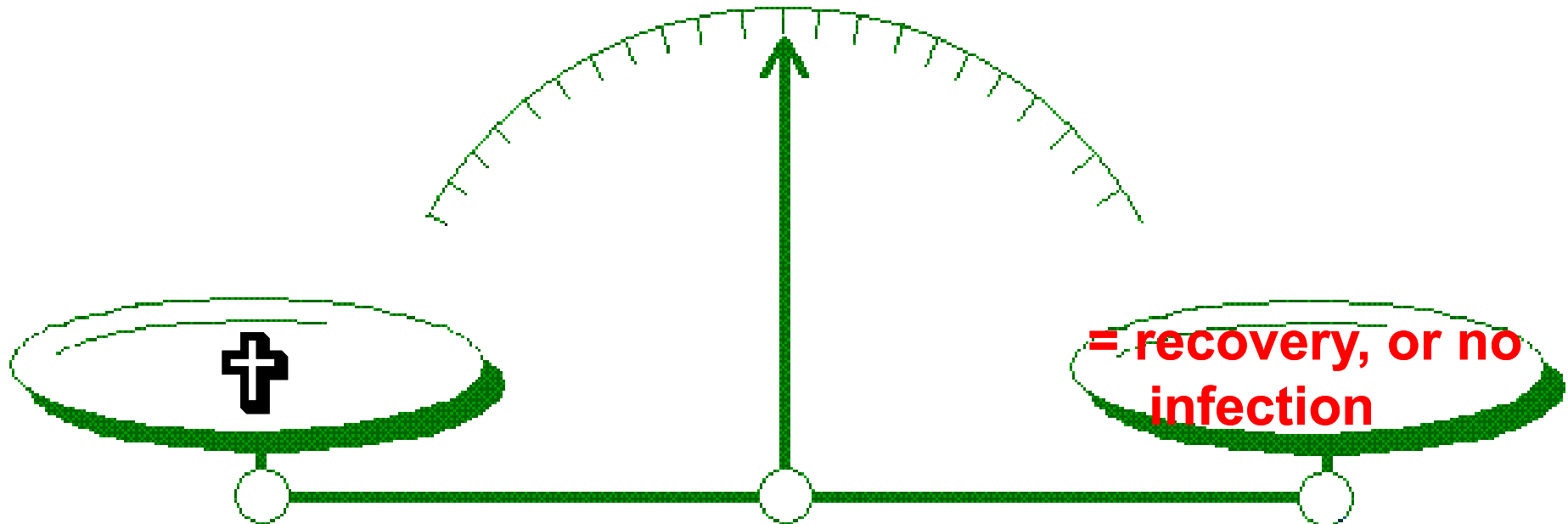
Nosocomial (hospital-acquired) infection: in connection with the stay in hospital, often opportunist one

Iatrogenic infection: caused by a medical intervention

Community-acquired infection: infection obtained in common population

Outcome of infection – revision

- Species pathogenicity
- Strain virulence
- High dosis
- Uncommon portal of entry
- Exaggerated reaction
- High species resistance of the host
- High non-specific resistance of the individual
- no risk factors
- no functional or anatomical defects
- Specific immunity and its quality



Immunization and its types I

Immunization = the process leading to the development of immunity

Active immunization

natural: after infection

artificial: after vaccination

Passive immunization

natural: by the transfer of maternal antibodies through the placenta and by breast-feeding

artificial: after an injection of immunoglobulin (antiserum)

Immunization and its types II

Immunization	natural	artificial
active	after infection	after vaccination
passive	by transfer of antibodies through placenta and during breast-feeding	after injecting antiserum (immunoglobulin)

Vaccination

Vaccination = administration of microbial antigens in the form of vaccines with the objective to achieve immunity

Origin of the word **vaccine**:

from the Latin **vacca, cow**

Why cow? Because **Jenner** in 1796 discovered the vaccination against smallpox by means of **fluid from cowpox pustules**

Protective antigens

There is no need to use whole microbes for the vaccination

It is better when the vaccine contains **only** so-called protective antigens

Protective antigens = such **antigens, antibodies** against which protect from infection

Examples of protective antigens:

diphtheric and tetanic **toxoids**

capsule antigens of pneumococci etc.

surface antigen of hepatitis B virus (HBsAg)

hemagglutinin and neuraminidase of influenza A virus

Types of vaccines

- **Toxoids (anatoxins)**
- **Inactivated vaccines**
- **Chemovaccines**
- **Recombinant vaccines**
- **Attenuated (live) vaccines**

Toxoids (anatoxins)

Toxoid (anatoxin) = bacterial toxin free from toxicity (e.g. by the action of formalin)

Its antigens must remain identical with the original toxin

Therefore antibody (antitoxin) developed against the toxoid can neutralize the original toxin

For better effect, the toxoid has been bound to the carrier called the adjuvant, e.g. $\text{Al}(\text{OH})_3$

Examples of toxoids:

- tetanic toxoid
- diphtheric toxoid
- staphylococcal toxoid

Inactivated vaccines I

Bacterial v. (bacterins) – from carefully killed bacterial suspensions; in practice now only so-called:

- **autovaccines** – from strains directly cultured from a patient – for treatment of allergic states (e.g. asthma bronchiale)
- **stockvaccines** – prepared for stock also for other patients

Both types are successful for treatment of **staphylococcal furunculosis (boils)** and **vaginal candidosis**

Inactivated vaccines II

Viral vaccines – from carefully killed virions:

- **influenza vaccine** (nowadays of the split-type from chemically disintegrated virions, with surface antigens from actually circulating strains)
- **Salk vaccine against poliomyelitis** – in advanced countries
- **antirabic vaccine**
- **vaccine against tick-borne encephalitis**
- **hepatitis A vaccine**

Chemovaccines I

From isolated protective antigens:

Bacterial chemovaccines:

against **pertussis** (acellular mixture of 3 antigens – pertussis anatoxin, filamental hemagglutinin and outer membrane protein)

against **Q-fever**

Viral chemovaccines:

against **influenza** – **subunit vaccine** from isolated hemagglutinin and neuraminidase

Chemovaccines II

Group of capsular polysaccharide vaccines:

against *Haemophilus influenzae* type b

against *Neisseria meningitidis* A and C

against pneumococcal infections (23valent)

against typhoid fever (from Vi antigen)

No cellular immunity follows (humoral only)
nor immunologic memory

For infants the polysaccharide vaccines
must be conjugated with a protein carrier

Recombinant vaccines

Recombinant vaccines = chemovaccines
made from genetically modified microbes
with an inserted gene for the production
of appropriate protective antigen

against hepatitis B (from yeasts with the
gene for HBsAg production)

against papillomaviruses genotypes 6, 11,
16 and 18 (from yeasts with the gene for
the virus surface protein)

Attenuated vaccines

Attenuated vaccines = live strains weakened
by culturing *in vitro*

Bacterial: BCG-vaccine from *M. bovis* –
against tuberculosis
vaccines against typhoid fever
and cholera

Viral: Sabin vaccine against poliomyelitis
vaccine against morbilli
mumps
rubella

Mixed vaccines

Mixed vaccines are nowadays used most frequently

Examples:

Hexavalent vaccine against 1) diphtheria, 2) tetanus, 3) whooping cough, 4) hepatitis B, 5) invasive infections by *Haemophilus influenzae* type b (conjugated) and 6) polio (inactivated)

Trivalent attenuated vaccine against 1) morbilli, 2) rubella and 3) mumps

Different kinds of vaccination

In most countries following kinds of vaccination are recognized:

- a) Regular
- b) Special
- c) Extraordinary
- d) At injuries and accidents, at not healing wounds and before some therapeutic interventions
- e) Before travelling abroad
- f) On request

a) Regular vaccination

= vaccination of every person of certain age, or of persons in higher risk of infection other than during work

It includes regular vaccination against:

- Diphtheria, tetanus, whooping cough, invasive disease caused by *Haemophilus influenzae* type b, infectious infantile paralysis (poliomyelitis) and viral hepatitis B
- Morbilli, rubella and mumps
- Viral hepatitis B (e.g. of dialyzed persons a.o.)
- Influenza and pneumococcal infections (e.g. persons in hospitals and old people's homes)

b) Special vaccination

= vaccination of persons in the higher risk of infection during pursuance of a profession

It includes special vaccination against:

- **Viral hepatitis B** (e.g. in laboratories with the biologic materials, in surgical departments, students of health professions)
- **Viral hepatitides A and B** (new members of rescue service system)
- **Rabies** (employees of respective institutions)
- **Influenza** (workers in old people's homes etc.)

c) Extraordinary vaccination

= vaccination in extraordinary situations

It includes extraordinary vaccination at:

- **Imminent outbreaks of e.g.**
 - influenza**
 - hepatitis A**
 - meningococcus meningitis**
- **Threat of an terrorist attack and things like that**

d) Vaccination at injuries etc.

**= Vaccination at injuries and accidents,
with not healing wounds and before
some therapeutic interventions like
surgery on rectum or large intestine**

It includes vaccination

- **against tetanus**
- **against rabies**

e) Vaccination before travelling abroad

Compulsory vaccination (according to the place of stay abroad)

against yellow fever and meningococcal meningitis, possibly revaccination against tetanus, poliomyelitis and diphtheria

Recommended vaccination against typhoid fever, cholera, Japanese encephalitis B, viral hepatitides A and B and rabies

f) Vaccination on request

**Vaccination on request = voluntary vaccination
(paid one)**

**Against influenza (except specified groups of
persons)**

tick-borne encephalitis

**papillomaviruses (except regular
vaccination of 13-years old girls)**

meningococci (except in outbreaks)

rotaviruses

**hepatitis A (except special vaccination of
rescuers)**

chickenpox

Contraindication of vaccination

Vaccination = stress, but not so great as some “would-be experts” try to scare the people

During the first week after it the resistance against infection decreases

Because of this the vaccination is sometimes contraindicated but only relatively

**As a rule following persons are not vaccinated:
sick**

suspect from infection

reconvalescent

substantially debilitated

Caution is advisable in pregnancy

in allergic states

Aim of vaccination

Aim of vaccination is

- **not only the protection of an individual**
- **but above all the protection of the whole population against transmission of infections**

Only the high number (at least 95 %) of vaccinated persons

- **prevents the transmission of agents of infection on non-immune individuals and**
- **therefore lowers the morbidity and mortality of the infection in question**

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Recommended reading material

Paul de Kruif: Microbe Hunters

Paul de Kruif: Men against Death

Axel Munthe: The Story of San Michele

Sinclair Lewis: Arrowsmith

André Maurois: La vie de Sir Alexander Fleming

Hans Zinsser: Rats, Lice, and History

Michael Crichton: Andromeda Strain

Albert Camus: Peste

Victor Heisser: An American Doctor Odyssey

Richard Preston: The Hot Zone

Mika Waltari: The Egyptian

Richard Gordon: Doctor in the House

Please mail me other suggestions at:

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Thank you for your attention