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COURSE AND FORMS OF INFECTION – I

The 10th lecture for the 2nd-year students,
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What is the pathogenesis? – revision

Pathogenesis explains the origin and development of pathological symptoms

What does the pathogenesis of infection include?

- The way the agent spreads through the macroorganism
- Mechanisms of defence against it
- Actual causes of symptoms:

  a) either the infectious agent itself,

  b) or the reaction of macroorganism to it

Spreading by means of lymph – revision

skin → regional lymphatic nodes: pyogenic cocci, *F. tularensis, Y. pestis*; arboviruses

oropharynx, tonsils → cervical nodes: *S. pyogenes, C. diphtheriae, M. tuberculosis,* anaerobes (*Actinomyces israeli*, *Prevotella*), *T. gondii*

lungs → hilar nodes: *M. tbc, B. anthracis,* other respiratory pathogens

genital mucosa → inguinal nodes: *Treponema pallidum, Ch. trachomatis* L1-L3, *H. ducreyi*

Peyer plaques → mesenteric nodes: *Yersinia enterocolitica*, enteric adenoviruses, enteroviruses

Spreading by means of blood – revision

Agents of all generalized infections: exanthematic viruses, enteroviruses, arboviruses, *Treponema pallidum*, *Salmonella* Typhi and many others

Agents of pneumonia commonly appear in blood: especially *Strept. pneumoniae*

Sometimes agents of other systemic and local infections: during meningitis, pyelonephritis (urosepsis), suppurating wounds and suchlike

Spreading *per continuitatem* – revision

From cell to cell: HSV, RSV, listeriae, yersiniae

By means of secretion down the mucosa: agents of respiratory, enteric and urogenital infections

From the site of arthropod biting to its vicinity: arboviruses, *Borrelia burgdorferi*

From the wound to adjacent tissue: *Streptococcus pyogenes, Clostridium perfringens*

From the middle ear to meninges: *S. pneumoniae, Haemophilus influenzae* type b

From lungs to pleura: agents of pneumonia

Spreading along nerves – revision

Either axonally (within nerve fibres)

or by progressive infection of Schwann sheath

HSV, VZV, B-virus, rabies virus

Mycobacterium leprae

Naegleria fowleri

tetanic toxin

Elimination of agent from the body – revision

From the mucosa of
respiratory tract
and oral cavity,
intestine,
urogenital tract,
eye

From skin lesions

By means of urine

From blood

Elimination from respiratory tract – revision

Sneezing:

in particular agents of common cold (rhinoviruses, coronaviruses),
from bacteria e.g. *Neisseria meningitidis*

Coughing:

other respiratory viruses (primarily influenza virus),
exanthematic viruses (VZV, morbilli virus, rubella virus),
Neiss. meningitidis, *Bordetella pertussis*, *Mycob. tuberculosis*, *Yersinia pestis*

Elimination from alimentary tract – revision

Saliva:

HSV, EBV, mumps virus, *Str. pyogenes*

Stool:

enteroviruses (incl. poliovirus), HAV, HEV

salmonellae incl. *Salm.* Typhi, shigellae, EPEC, ETEC etc., *V. cholerae, C. difficile*

Entamoeba histolytica, Giardia lamblia

Ascaris lumbricoides, Taenia saginata

Elimination from urogenital tract – revision

From diseased mucosae:

Agents of classic venereal infections: in Europe
Neiss. gonorrhoeae, Treponema pallidum

Agents of other sexually transmitted diseases (STD):
***Chlamydia trachomatis* serotypes D-K, papillomaviruses, HSV-2**

By means of urine:

***Salmonella* Typhi**

Agents of congenital infections (rubella virus, CMV)

Exotic viruses of hemorrhagic fevers (Ebola)

Elimination from skin lesions – revision

Staphylococcus aureus

Streptococcus pyogenes

Varicella-zoster virus (agent of chickenpox and shingles)

Papillomaviruses (agents of warts)

Dermatophytes (e.g. *Trichophyton rubrum, Microsporum canis, Epidermophyton floccosum*)

***Sarcoptes scabiei* (itch-mite)**

Elimination from blood – revision

By means of vectors:

tick-borne encephalitis virus – ticks, yellow fever virus – mosquitoes

***Rickettsia prowazekii* – lice, *Yersinia pestis* – fleas, *Borrelia recurrentis* – lice**

Malaric plasmodia – mosquitoes

By means of small cracks in mucosa: HBV, HIV

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Infection

Definition:

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

Infection colonization:

Infection **= situation when an etiological agent**

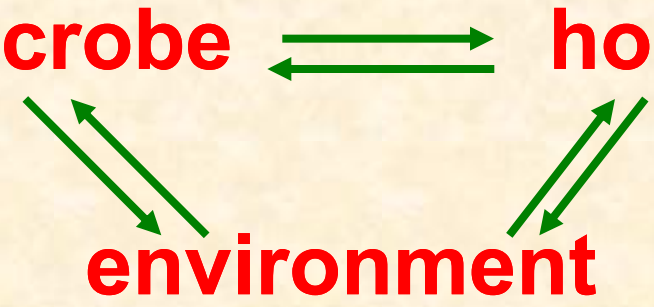
1) **penetrates into an organism and multiplies in it, or**
2) **it settles on bodily surfaces (skin or mucosae) and unfavourably affects them**

Colonization **= situation when**

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

Relationship between the microbe and the host – revision

The relationship is a dynamic one and influenced by the environment:



Illness is not a rule – peaceful coexistence is usually better for the parasite

In spite of that the host tries to get rid of the parasite – to destroy, remove or at least to keep it in one spot

Course of infection – I

Four components can be distinguished during the course of infection:

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

Course of infection – II

Incubation time

salmonellosis ½–1 day, influenza 1–2 days, tbc 2–8 weeks, hepatitis B 90–100 days

Prodromes

not always; nonspecific (↑T, headache, feeling ill etc.), several hours to days

Typical syndrome of infectious disease

as described in textbooks

Convalescence

from subsiding troubles till normalization of laboratory results (except antibodies!)

Course of infection – III

Relapse

the same agent, infection comes on again during the convalescence

Recurrence

the agent remains in the body, infection comes on again only after recovery (Brill-Zinsser disease = recurrence of epidemic typhus)

Reinfection

new infection by the same agent from outside

Superinfection

infection by another agent before recovery from the first infection

Forms of infection

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 textbooks

foudroyant, fulminant: very abrupt, with dramatic symptoms

Duration of infection

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

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 pyodermia, 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)

Focal infection – I

Focal infection theory:
chronic infection limited to a certain focus can result in a systemic illness with symptoms in quite a different site

Concept of focal infection used to be very fashionable formerly in diverse medical branches

In the name of so-called sanation of focuses thousands of patients were bona fide subjected to tooth extractions, tonsillectomies, cholecystectomies and other surgical interventions without proving the usefulness of these procedures by controlled studies

Focal infection – II

The connection between systemic disease and a local infection has been proved only in

- ***rheumatic fever*** **– inflammation of heart, kidneys and joints after tonsillar infection by *Streptococcus pyogenes***
- ***Reiter's syndrome*** **– reactive arthritis after**
  1. sexually transmitted urogenital infection by *Chlamydia trachomatis* serotypes D-K,
  2. intestinal infection caused by pathogens from genus *Salmonella, Shigella, Yersinia* or *Campylobacter*
- ***hemolytic-uremic syndrome*** **after intestinal infection by *Escherichia coli* serotype O157:H7**
- ***sterile mykids*** **e.g. on palms during tinea pedis**

Special types of chronic infections

Inapparent chronic infections can be clasified as

1. *latent*: agent hides in a non-infectious form, or it escapes from the infected cell after an activation of infection only

   HSV and VZV: nerve ganglia cells, CMV: kidney and salivary glands cells, EBV: lymphocytes

2. *persistent*: agent can be detected by routine methods, because it is present mostly in an infectious form

Both types are markers of failing immunity

Both types can be activated

Examples of persistent infections

Bacterial: ***Rickettsia prowazekii*** (activation of exanthematic typhus = m. Brill-Zinsser), ***Salmonella*** Typhi (carriers), ***Mycob. tbc*** (lymphatic nodes)

Viral: HBV (hepatocytes), adenoviruses (adenoids), JCV and BKV (kidneys), congenital infections by CMV and rubella virus

Parasitary: hypnozoites of ***Plasmodium ovale*** and ***P. vivax*** (liver), ***Toxoplasma gondii*** bradyzoites (nodes, muscles, brain)

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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

Please mail me other suggestions at:

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Thank you for your attention