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PATHOGENESIS OF INFECTION – II

The 9th lecture for 2nd-year students cancelled because of Easter Monday 2015

What is the pathogenesis? – revision

Pathogenesis explains the origin and development of pathological symptoms

What does the pathogenesis of infection include?

1. **The way the agent *spreads* through the macroorganism**
2. **Mechanisms of *defence* against it**
3. **Actual *causes of symptoms:***

   a) either the infectious agent itself,

   b) or the reaction of macroorganism to it

Spread of the agent through the macroorganism – revision

→ portal of entry (skin, mucosae, placenta)

→ sites of primary multiplication:
portal of entry vicinity (= primary affect)
regional lymphatic nodes (+ primary affect = primary complex)

→ actual spread (dissemination of agent):
by means of lymph, blood, per continuitatem, along nerves

→ target organ: typically in viral diseases

→ sites of elimination from macroorganism:
may not be the same as portal of entry

PORTALS OF the infectious agent's ENTRY – revision

Mucosae

- respiratory ways and lungs
- alimentary tract
- urogenital tract
- conjunctiva and cornea

Skin and hypodermis

Placenta

Respiratory tract mucosa I – revision

NOSE + NASOPHARYNX: respiratory viruses (rhinoviruses, coronaviruses, adenov.), HSV, viruses of exanthematic infections (measles, rubella, chickenpox), amoebae (*Naegleria , Acantamoeba, Balamuthia*)

Secondary bacterial agents: *Haemophilus influenzae* b, *Strept. pneumoniae, Staph. aureus, Moraxella catarrhalis* – the gang of 4

Chronic infections: ditto + *Klebs. pneumoniae* ssp. *ozaenae, Kl. pn.* ssp. *rhinoscleromatis*

Respiratory tract mucosa II – revision

TONSILS + PHARYNX: respiratory viruses, HSV, Epstein-Barr v., coxsackieviruses A; *Streptococcus pyogenes*, other β-hemolytic streptococci, *S. pneumoniae, S. aureus, H. influenzae* serotype b, *Neisseria meningitidis, N. gonorrhoeae, Arcanobacterium haemolyticum, Corynebacterium diphtheriae; Candida albicans; Toxoplasma gondii*

EPIGLOTTIS: *Haemophilus influenzae* type b

Respiratory tract mucosa III – revision

LARYNX + TRACHEA: parainfluenza viruses, influenza viruses, RSV, adenoviruses; *Chlamydia pneumoniae, Mycoplasma pneumoniae, Corynebacterium diphtheriae*

Secondarily: *S. aureus, H. influenzae*

BRONCHI: influenza v., adenoviruses, RSV, parainfluenza v., RSV; *M. pneumoniae, Ch. pneumoniae, Bordetella pertussis*

Sec.: *S. pneumoniae, H. influenzae* type b, *Staph. aureus, Moraxella catarrhalis*

BRONCHIOLES: RSV

Lungs – revision

BRONCHOPNEUMONIA (alveoli & bronchi): *Str. pneumoniae, Staph. aureus, H. influenzae* type b*; Legionella pneumophila, Klebsiella pneumoniae, E. coli, Pseudomonas aeruginosa; Francisella tularensis, Yersinia pestis*

ATYPICAL PNEUMONIA (intersticium): *Mycopl. pneumoniae,* influenza virus A, *Ch. pneumoniae*; *Chlamydia psittaci* (ornithosis), *Coxiella burnetii* (Q fever); *Pneumocystis jirovecii,* CMV, atypical mycobacteria, *Nocardia asteroides*

SUBACUTE & CHRONIC PNEUMONIA:

- anaerobes (*Bacteroides fragilis, Prevotella, Peptostreptococcus*)
- *Mycobacterium tuberculosis*

Gastrointestinal tract mucosa – revision

ORAL CAVITY: HSV, *Candida albicans*

OESOPHAGUS: CMV, *C. albicans*

STOMACH: *Helicobacter pylori*

SMALL INTESTINE: *Campylobacter jejuni,* salmonellae (incl. *Salmonella* Typhi), ETEC, EPEC etc., *Yersinia enterocolitica, Vibrio cholerae*; enteroviruses (polio!), rotaviruses, noroviruses; *Giardia lamblia, Cryptosporidium parvum;* tapeworms, pinworms, roundworms, flukes etc.

LARGE INTESTINE + RECTUM: *Shigella sonnei* (bacterial dysentery), *Entamoeba histolytica* (amoebic dysentery)

Urogenital tract mucosa – revision

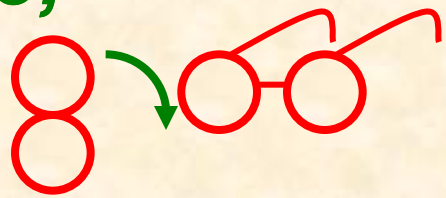
CLASSIC VENEREAL INFECTIONS:

Neisseria gonorrhoeae **(gonorrhoea),** ***Treponema pallidum*** **(syphilis),** ***Haemophilus ducreyi*** **(chancroid),** ***Klebsiella granulomatis*** **(granuloma inguinale),** ***Chlamydia trachomatis*** **serotypes L1-L3 (lymphogranuloma venereum)**

OTHER SEXUALLY TRANSMITTED DISEASES (STD): ***Ch. trachomatis*** **D-K,** ***Mycoplasma hominis, Ureaplasma urealyticum;*** **papillomaviruses, HBV, HCV, HSV-2, HIV-1;** ***Candida albicans; Trichomonas vaginalis***

Conjunctiva and cornea – revision

CONJUNCTIVA: ***Str. pneumoniae, S. aureus, H. influenzae, Moraxella lacunata; Chlam. trachomatis*** **D-K, *N. gonorrhoeae*; adenoviruses (types 3, 8, 19), enteroviruses (type 70), HSV**



CORNEA: ***S. aureus, Strept. pneumoniae, P. aeruginosa; Acanthamoeba castellanii; Bacillus cereus;*** **oportunistically pathogenic moulds; HSV, VZV, adenoviruses (type 8)**

Skin and hypodermis I – revision

INTACT SKIN: leptospirae, larvae of hookworms (*Ancylostoma duodenale, Necator americanus*) and *Strongyloides stercoralis*, cercariae of schistosomes, bilharziellae and trichobilharziae (swimmers itch)

SMALL CRACKS IN SKIN: *S. aureus, S. pyogenes, Bacillus anthracis, F. tularensis, Rickettsia prowazekii;* wart viruses, milker´s nodes v., cowpox virus; dermatophytes

BITE OF ARTHROPODS: arboviruses; borreliae, ehrlichiae, rickettsiae, coxiellae, bartonellae, *Yersinia pestis*; malaric plasmodia, leishmaniae, trypanosomes & others)

Skin and hypodermis II – revision

WOUNDS: *S. aureus, S. pyogenes, Clostridium tetani,* gas gangrene clostridia, coagulase negative staphylococci etc.

WOUNDS AND BITES BY ANIMALS: rabies v., *Spirillum minus, Pasteurella multocida, Capnocytophaga canimorsus, S. aureus, Streptobacillus moniliformis; Erysipelothrix rhusiopathiae* (erysipeloid), *Burkholderia pseudomallei*

BURNS: *Pseudomonas aeruginosa,* pyogenic cocci

Skin and hypodermis III – revision

WOUNDS IN WATER: ***Pseudomonas aeruginosa, Aeromonas hydrophila*; *Vibrio vulnificus, V. parahaemolyticus, Mycobacterium marinum***

WOUNDS IN THE TROPICS: ***Dermatophilus congolensis, Rhodococcus equi, Mycobacterium ulcerans, Mycob. marinum; Sporothrix schenckii* and many other micromycetes**

Placenta – revision

Congenital infections **(= infections acquired during pregnancy)**

VIRAL: rubella v. (*Rubivirus*), parvovirus B19 (*Erythrovirus*), cytomegalovirus (CMV), varicella-zoster v. (VZV), herpes simplex v. (HSV)

BACTERIAL: *Treponema pallidum, Listeria monocytogenes*

PARASITIC: *Toxoplasma gondii*

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SPREAD OF INFECTION
(dissemination of the agent)

By means of

a) lymph

b) blood

c) per continuitatem

d) along nerves

a) Spreading by means of lymph

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

b) Spreading by means of blood

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*

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

c) Spreading *per continuitatem*

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

d) Spreading along nerves

Either axonally (within nerve fibres)

or by progressive infection of Schwann sheath

Herpes simplex v., varicella-zoster v., B-virus, rabies virus

Mycobacterium leprae

Naegleria fowleri

tetanic toxin

ELIMINATION OF AGENTS FROM THE BODY

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

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

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

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

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

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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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

Michael Crichton: Andromeda Strain

Albert Camus: Peste (The Plague)

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