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PATHOGENESIS OF INFECTION – I

**The 8th lecture for 2nd-year students
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Three elements of pathogenicity and virulence – revision

1. Communicability (transmissibility) = ability to be transmitted between hosts
2. Invasiveness = ability to:
 - enter the host
 - multiply within
 - spread through it } = { ability to overcome the defence
3. Toxicity = ability to do harm to the host

How do microbes face immunity A – revision

A) Ability to overcome the innate immunity:

- *Resisting complement*
inhibiting complement activation
protecting their own surface
- *Resisting phagocytosis*
avoiding being engulfed (capsule!)
surviving inside the phagocyte
- *Interfering with the cytokine function*

How do microbes face immunity B – revision

B) Ability to overcome the acquired immunity:

**Always an attempt to avoid antibodies
or immune lymphocytes by**

- 1) quick reproduction* (respiratory viruses, diarrhoeal agents, malarial plasmodia)**
- 2) attempting to deceive* immune system
to hide
to change one's own antigens
to induce tolerance**
- 3) attempting to suppress* immune reaction**

Toxicity I – revision

Damage by direct effect of infectious agent

- Cellular death

lysis by toxins, viruses, immune lymphocytes
apoptosis (HSV, shigellae)

- Metabolic injury – influence of exotoxins

- Mechanical causes (schistosomal eggs, *P. jirovecii*, pseudomembranes in diphtheria)

The most frequent cause of death in bacterial infections → septic shock triggered by endotoxins

G – : lipopolysaccharide

G + : teichoic acid + peptidoglycan

Toxicity II – revision

Damage as a result of defence reactions – a)

a) Injuries caused by inflammatory reaction:
calor, rubor, tumor, dolor, functio laesa
= typical markers of inflammation
= symptoms of disease

edema: encephalitis, epiglottitis

inflammatory infiltrate: pneumonia

suppuration: blennorrhoea neonatorum

formation of connective tissue: scarring

Toxicity III – revision

Damage as a result of defence reactions – b)

b) Injuries caused by specific immune reaction
(immunopathological consequences of hypersensitivity)

1st type: (IgE, anaphylaxis) helminthoses

2nd type: (cytotoxicity) hepatitis B, febris rheumat.

3rd type: (immunocomplexes) farmers lungs,
poststreptococcal nephritis, systemic reactions
during sepsis

4th type: (late, cellular) tbc, lepra, syphilis,
actinomycosis, rash in measles

What is the pathogenesis?

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

- 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

Mucosae

respiratory ways and lungs

alimentary tract

urogenital tract

conjunctiva and cornea

Skin and hypodermis

Placenta

Respiratory tract mucosa – I

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

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

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

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

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

CLASSIC VENEREAL INFECTIONS:

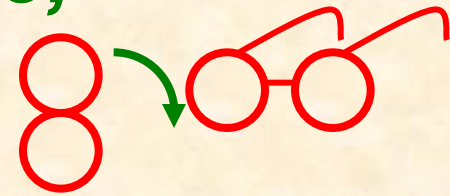
Neisseria gonorrhoeae (gonorrhoea),
Treponema pallidum (syphilis),
Haemophilus ducreyi (chancroid), *Klebsiella granulomatis* (granuloma inguinale),
Chlamydia trachomatis serotypes L1-L3
(lymphogranuloma venereum)

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

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; opportunistically
pathogenic moulds; **HSV**, **VZV**,
adenoviruses (type 8)

Skin and hypodermis – I

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

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

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

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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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

Please mail me other suggestions at:

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Thank you for your attention