Chapter 4

The infection and pathogenic mechanism of bacteria

Occurrence and development of bacterial infection

Origin of infection

1. Exogenous infection
   (1) patient
   (2) carrier
   (3) animal
2. Endogenous infection
   normal flora

The mode of infection

Horizontal transmission

person ⟷ person ← animal

(zoonosis)

Vertical transmission

mother → offspring

placenta

birth canal

breast milk

The route of infection

1. respiratory tract
2. digestive tract
3. damaged skin or mucous membranes
4. blood
5. arthropod vector
6. contact: sex contact (STD)

The type and outcome of infection

Ⅰ. inapparent infection

Ⅱ. apparent infection

Ⅲ. whole body infection

Ⅳ. carrier state

apparent infection

acute infection
chronic infection

local infection
systemic infection

furuncle
carbuncle

bacteremia
toxemia
septicemia
pyemia

whole body infection

***toxemia*: is the presence of exotoxin in the blood.**

***pyemia*: is caused by purulent microorganisms in the blood.**

***endotoxemia*: is the presence of endotoxin in the blood.**

***septicemia*: illness that occurs when poisonous substances (toxins) produced by certain bacteria enter the bloodstream.**

***bacteremia*: is an invasion of the bloodstream by bacteria.**

Bacterial Pathogenesis Mechanism

virulence:

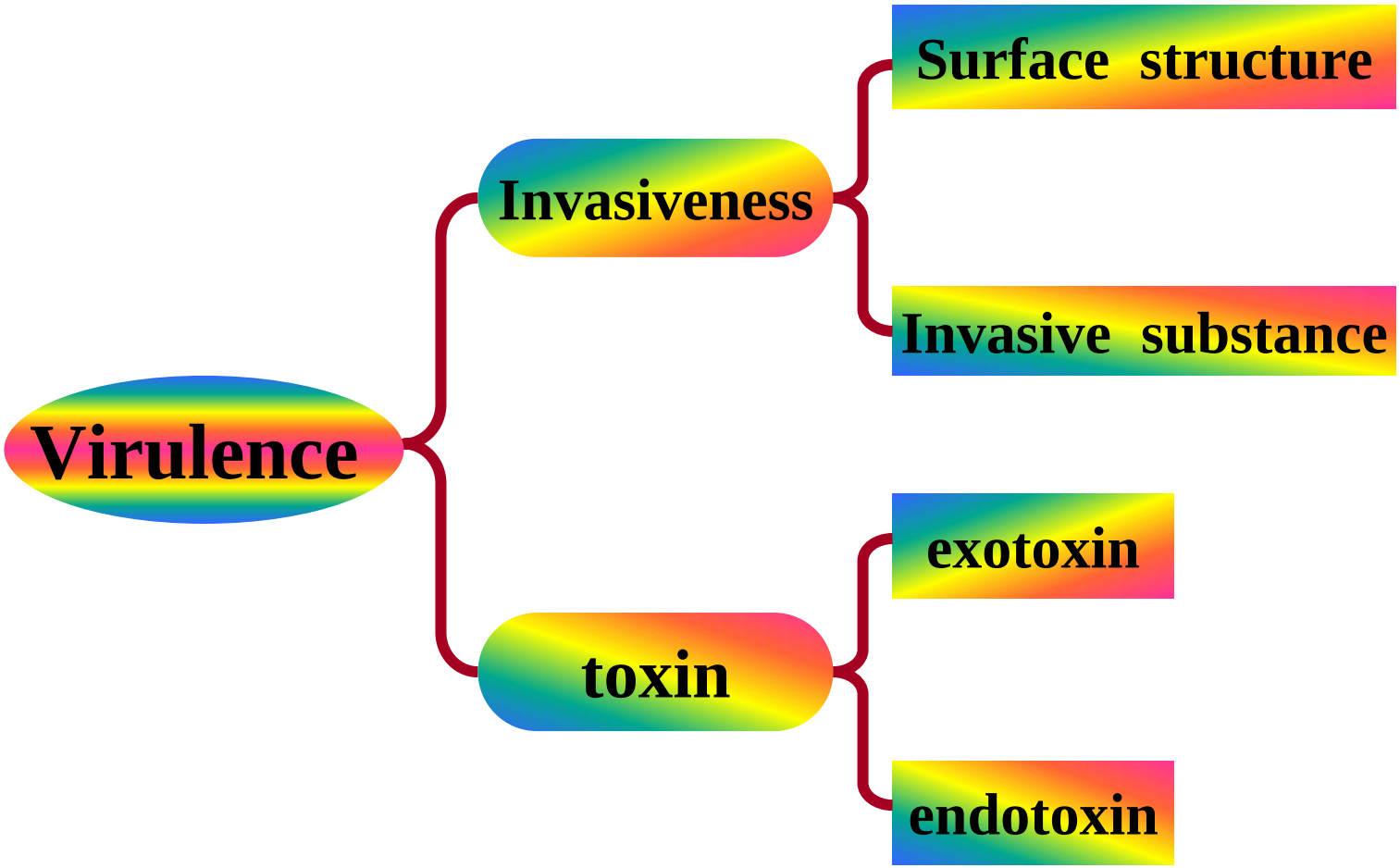
refers to extent of pathogenicity.

median lethal dose(LD50):

The number of pathogens required to cause lethal disease in half of the exposed hosts is called an LD_{50}.

median infective dose(ID50):

The number of pathogens required to cause disease (or, at least, infection) in half of the exposed hosts is called the ID_{50}.


Virulence
Invasiveness
Surface structure
Invasive substance
toxin
exotoxin
endotoxin

(I) Invasiveness:

The ability of bacterium to resist host defence, colonize, multiply and spread.

1.adhesion ------surface structure

❶ bacteria to host cell:

pili

capsule

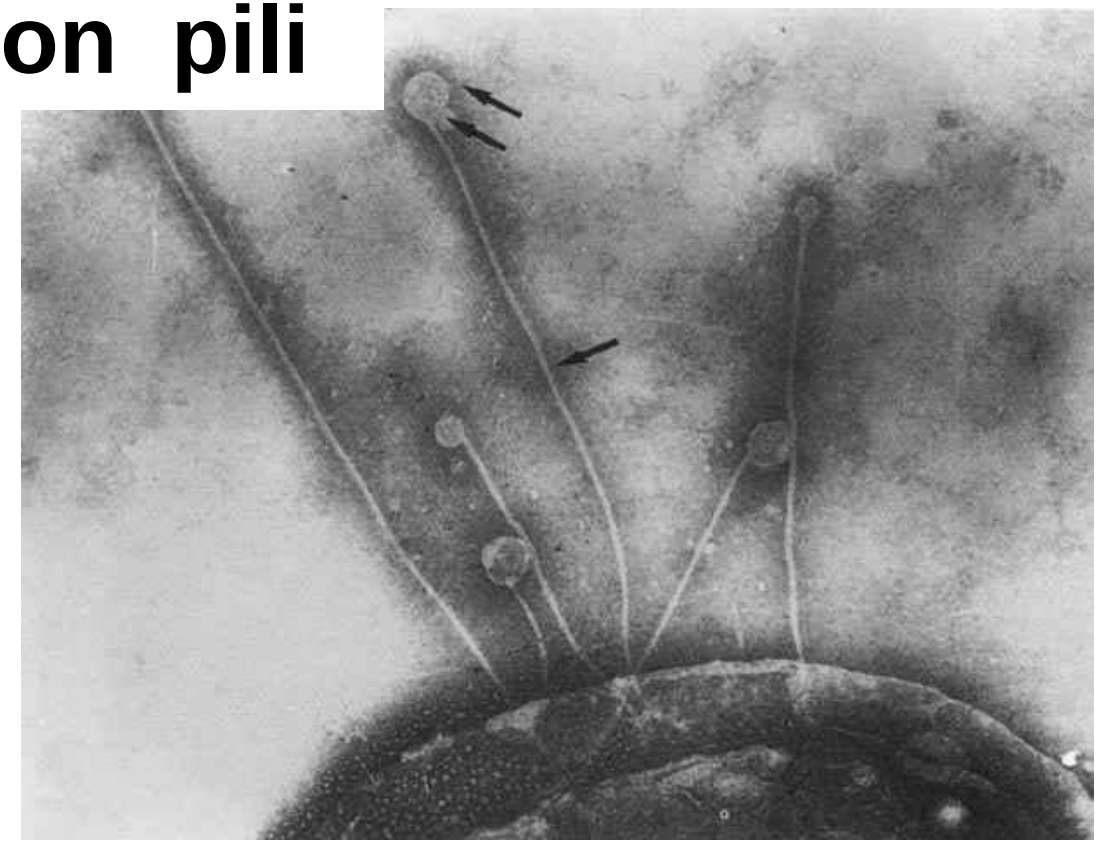
colonization factor

❷bacteria to bacteria:

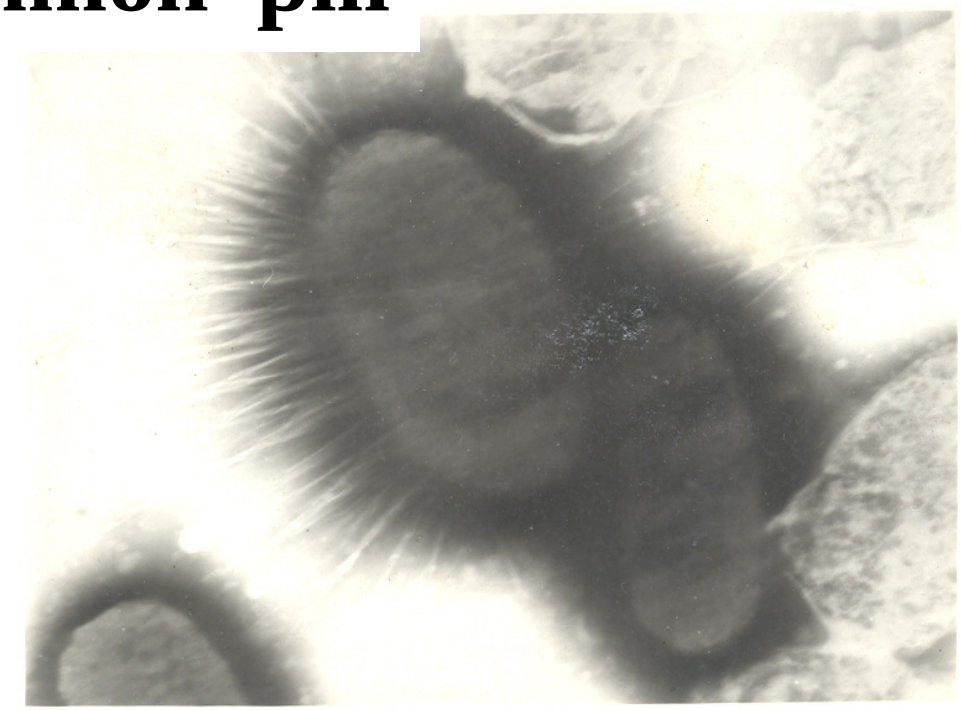
microcolony

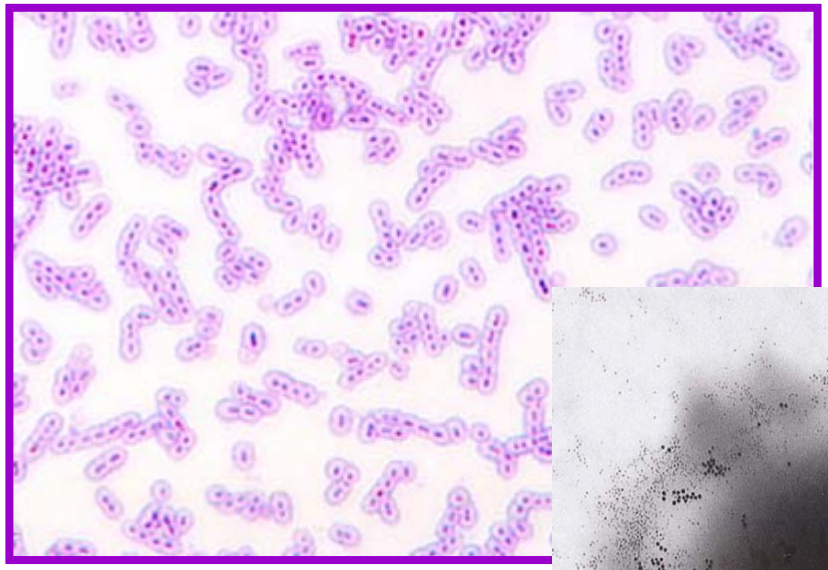
biofilm

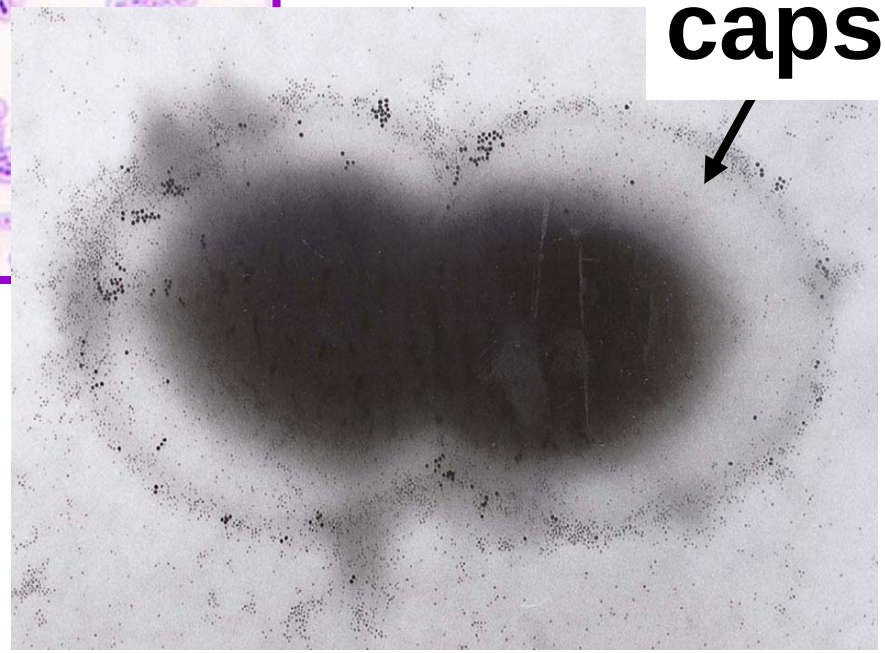
common pili



common pili

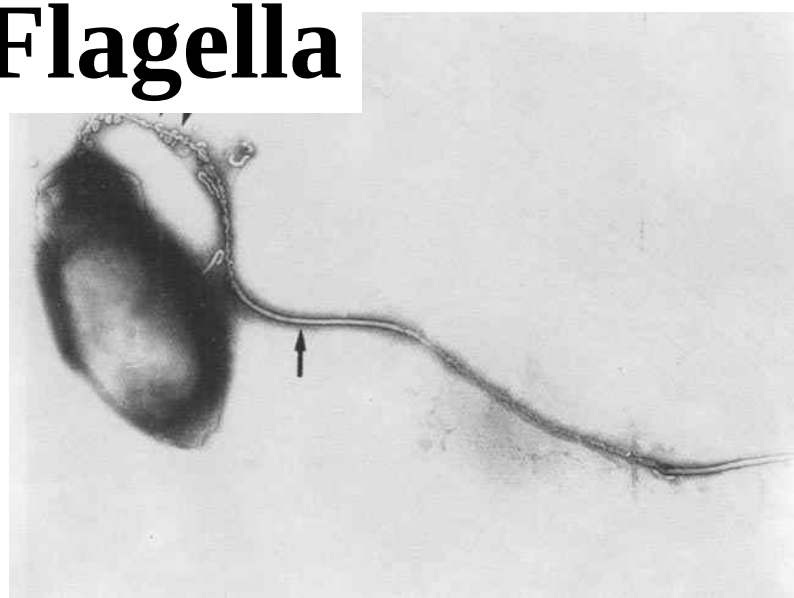






capsule

Flagella



2.Penetration and spread

capsule

invasive enzyme **--- exoenzyme**

- ***coagulase*****--- S. aureus**

  fibrinogen→fibrin → surround bacteria

- ***hyaluronidase*** **(spreading factor)**

hydrolyze hyaluronic acid tissue loose, B. spreads

- ***streptokinase. SK*** **----Lyse fibrin**
- ***streptodornase, SD*****---resolve DNA.**

microcolony and biofilm

(II). toxin

1.exotoxin：

- **excreted by living cells, G^+ bacteria**
- **polypeptide**
- **Heat-unstable, 60° C, 1-2hr destroy**
- **Strong antigenicity，exotoxin→ toxoid**
- **highly toxic**
- **high selection for tissues**

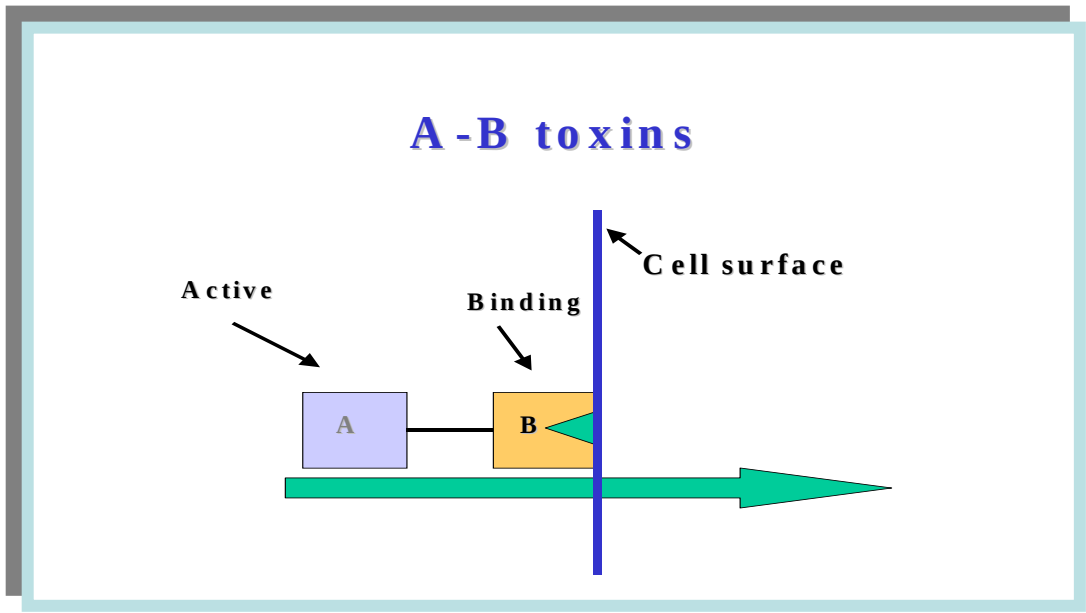
neurotoxin
cytotoxin
enterotoxin

- **structure： A subunit-B subunit**

exotoxin

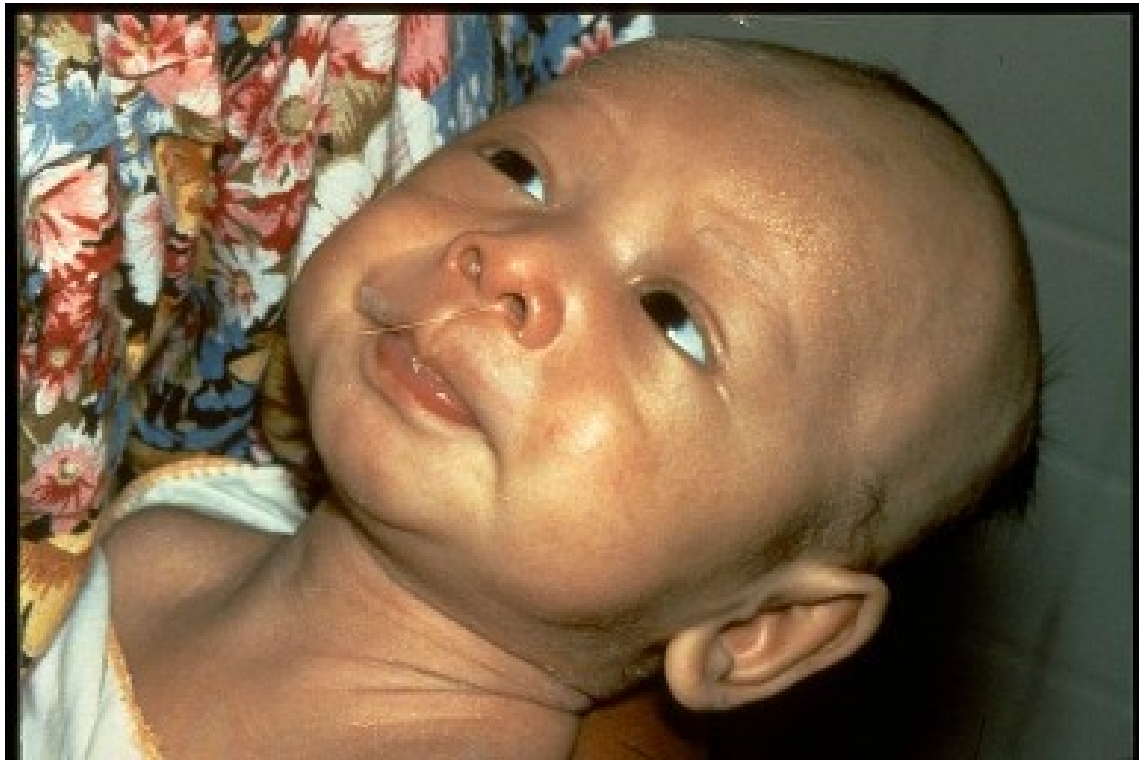
subunit A：toxicity active

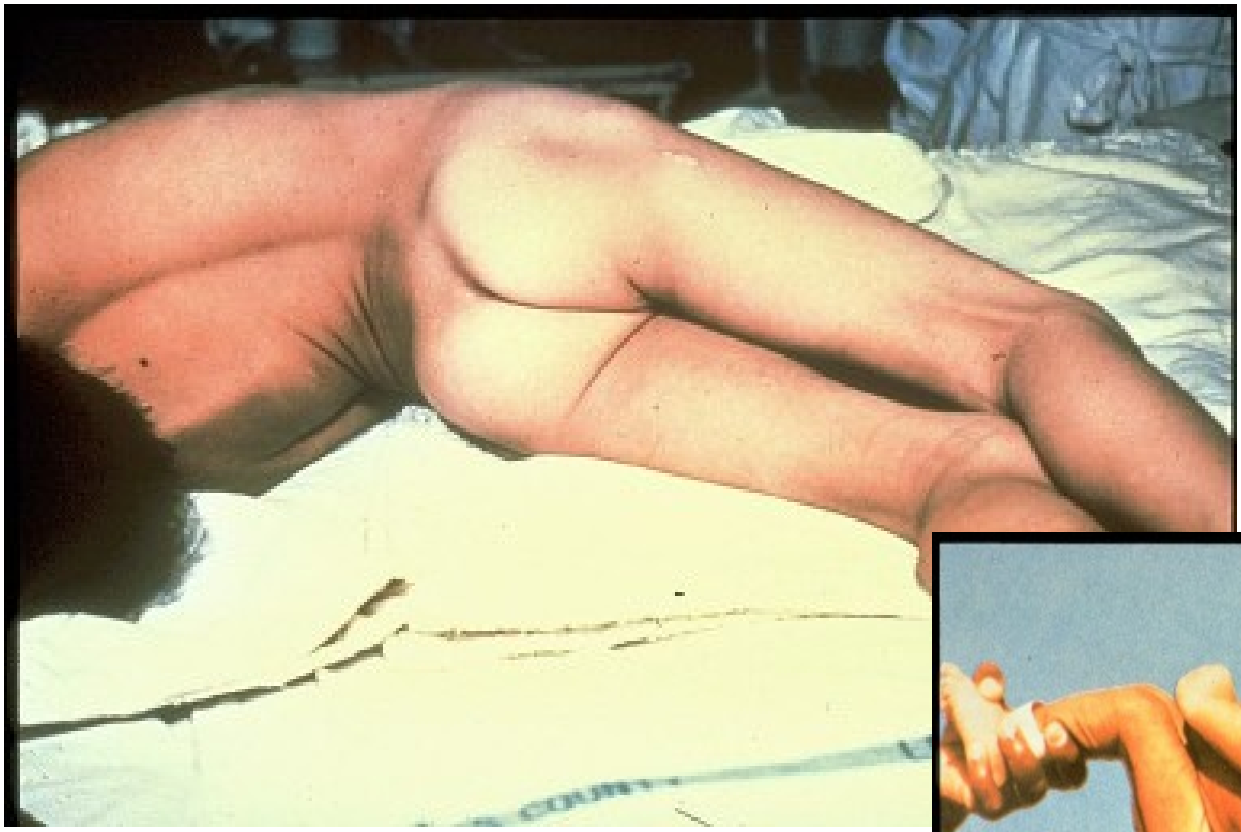
subunit B: non-toxicity , bind receptor of sensitive cell



exotoxin

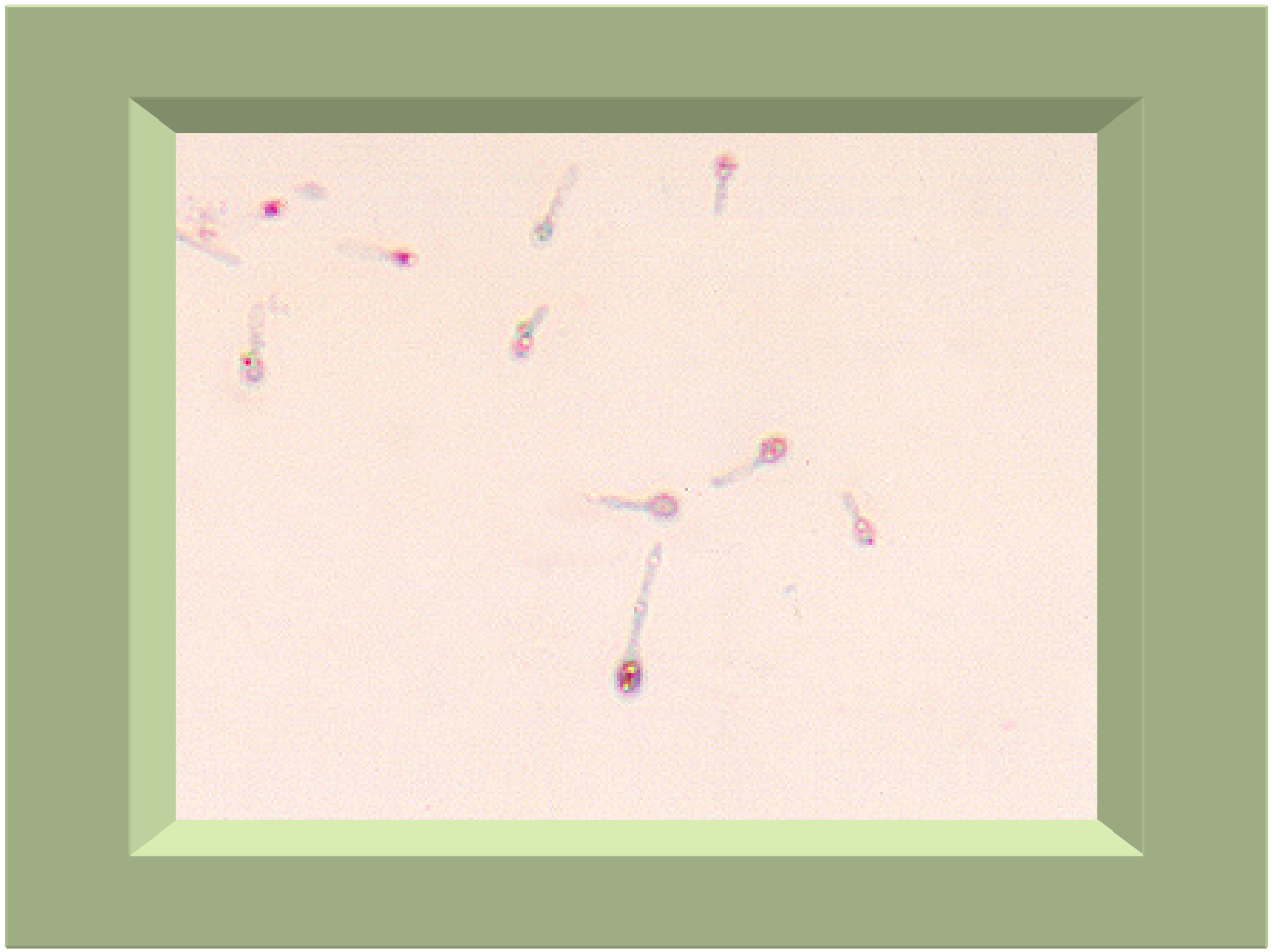
- **neurotoxin：tetanospasmin spinal cord**
- **cytotoxin: diphtherotoxin inhibit cell protein synthesis**
- **enterotoxin: cholera toxin**





A severe case of tetanus.
muscles, back and legs are rigid
muscle spasms can break bones
can be fatal (e.g respiratory falure)

Clostridium tetani



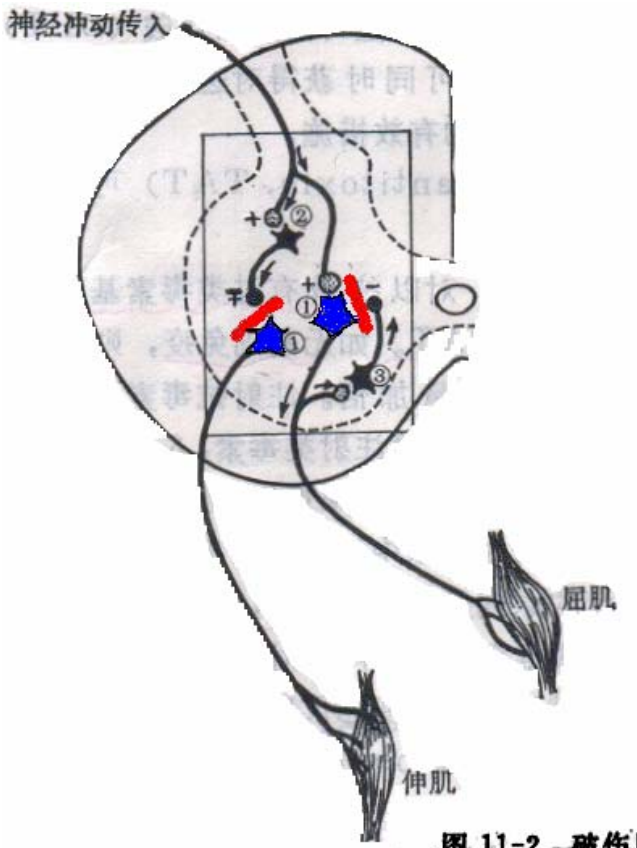
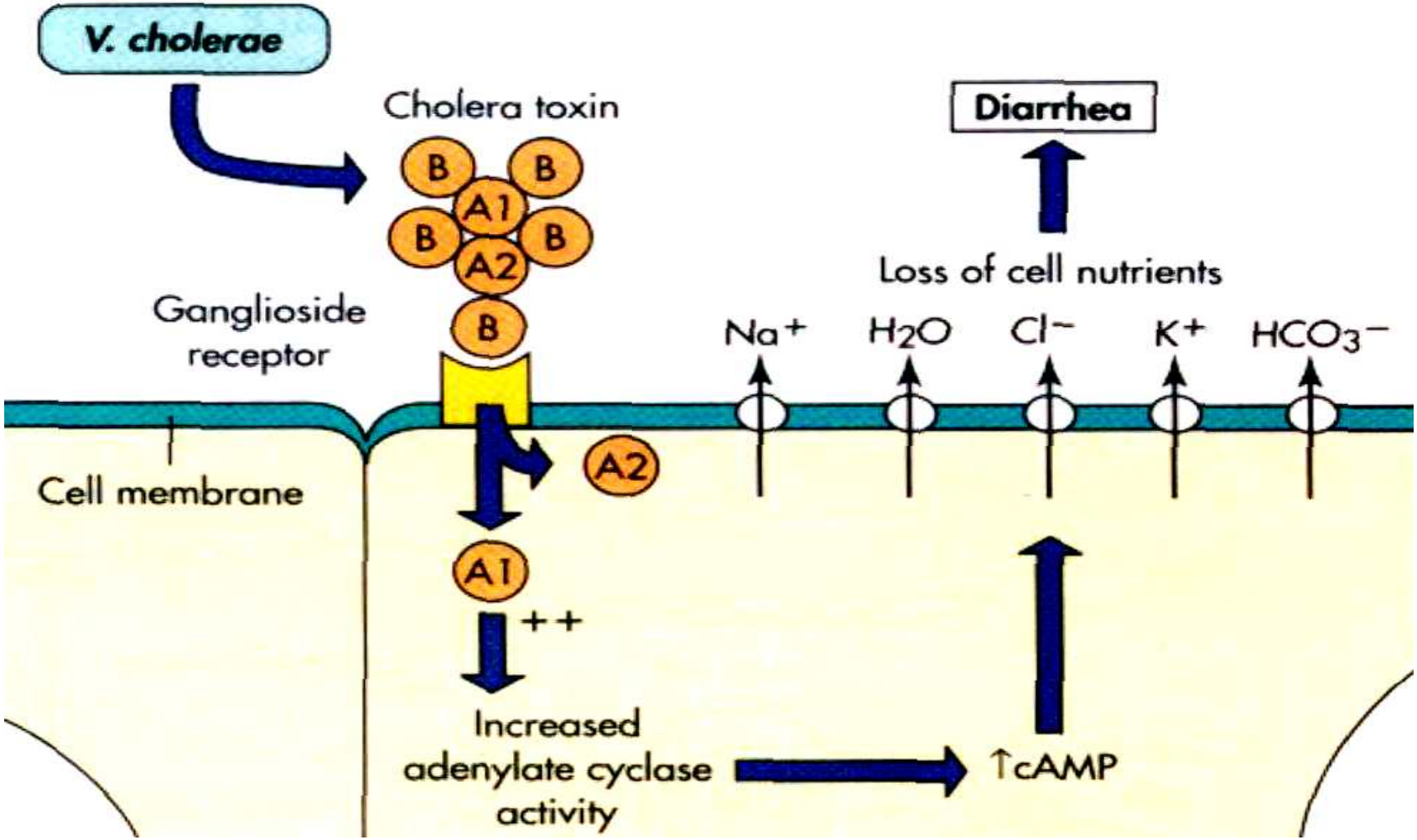
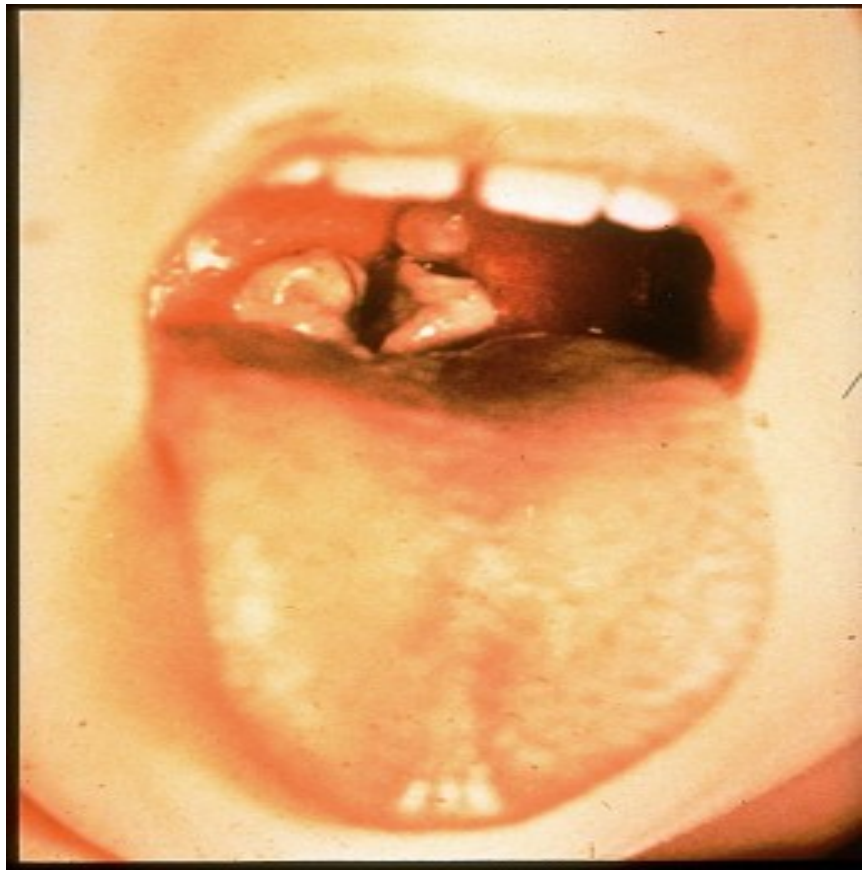


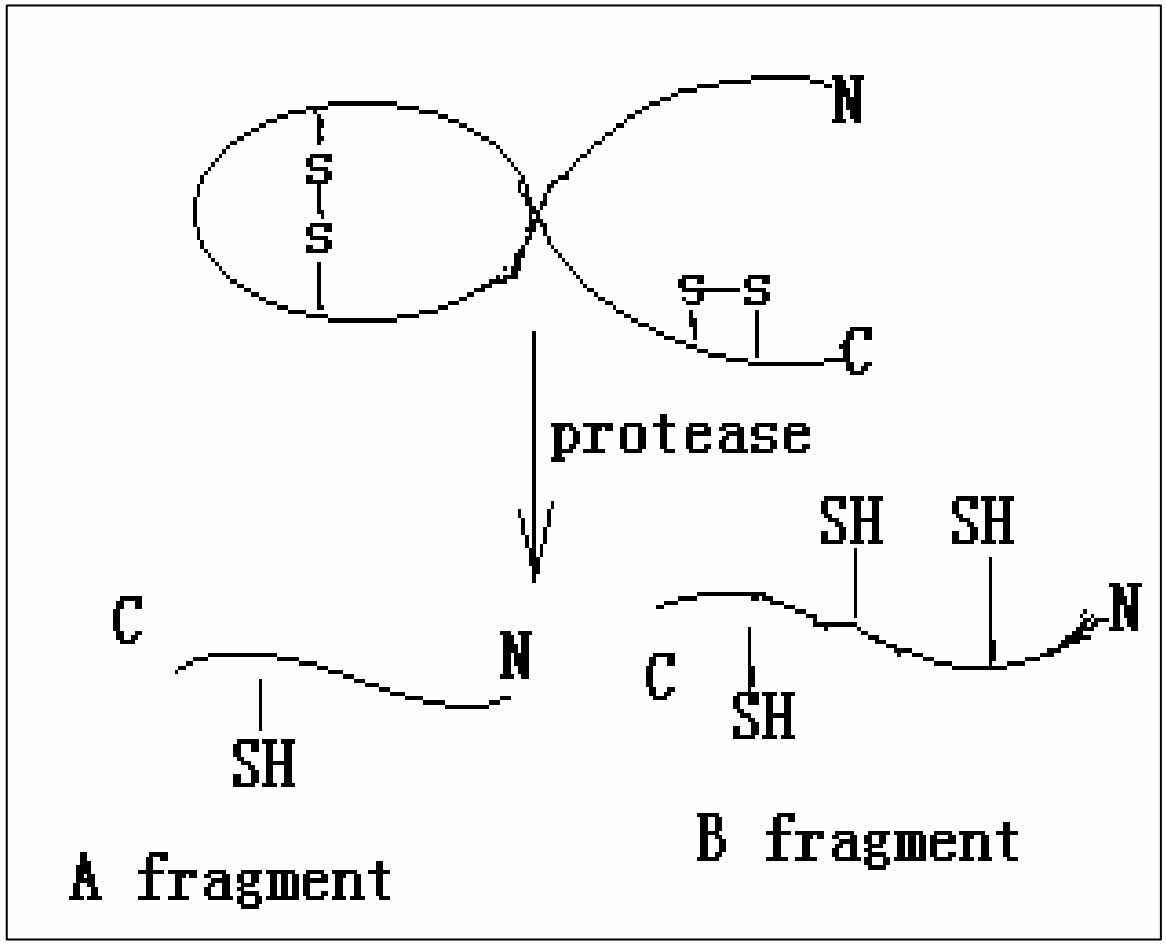
图 11-2 破伤风毒素的作用机理

①运动神经元；②抑制性中间神经元；③Ren shaw 细胞；＋兴奋；－抑制


V. cholerae
Cholera toxin
B
B
A1
B
B
A2
B
Ganglioside receptor
Cell membrane
A2
A1
++
Increased adenylate cyclase activity
↑cAMP
Diarrhea
Loss of cell nutrients
Na+
H2O
Cl−
K+
HCO3−



This child has diphtheria resulting in a thick gray coating over back of throat. This coating can eventually expand down through airway and, if not treated, the child could die from suffocation


N
S
S
S
S
C
protease
SH
SH
C
N
C
N
SH
SH
A fragment
B fragment

2. endotoxin

- integral part of G⁻ bacteria cell wall.
  release after bacteria disintegration
- LPS, main toxic part: Lipid A
- heat-stable: 160℃ 2-4hr
- can't converted into toxoid
- weakly toxic
- non-specificity

all endotoxins produce the same symptoms.

❶fever ❷ WBC reaction ❸ endotoxemia and shock
❹ Shwartzman and DIC

内毒素结构示意图