Treatment of Respiratory Tract Infections

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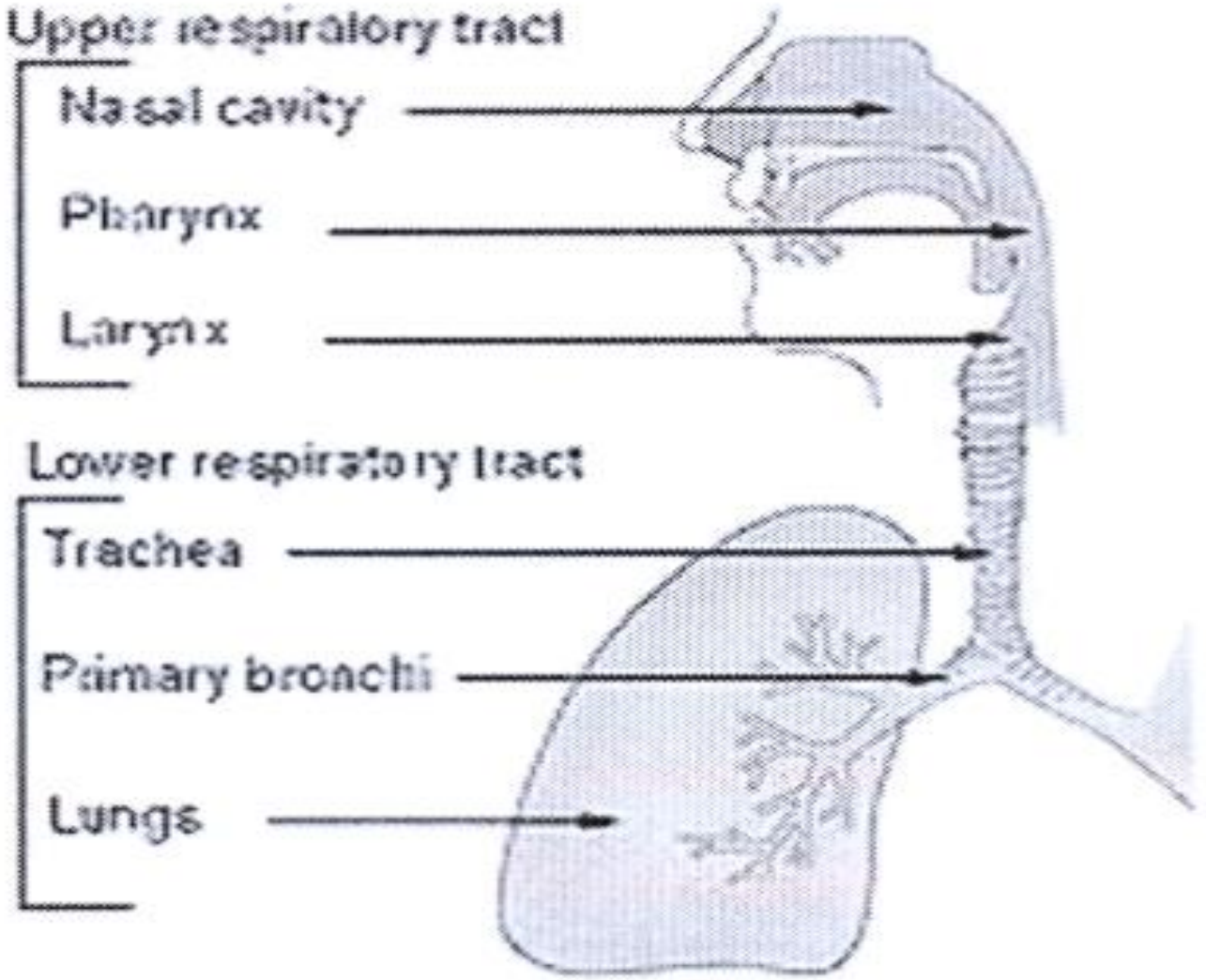
Objectives of the lecture

- At the end of lecture , the students should be able to understand the following:
- The types of respiratory tract infections
- The antibiotics that are commonly used to treat respiratory tract infections and their side effects.
- Understand the mechanism of action, pharmacokinetics of individual drugs.


Upper respiratory tract
Nasal cavity
Pharynx
Larynx
Lower respiratory tract
Trachea
Primary bronchi
Lungs

Causes of URTI›s

- **Viruses**(rhinoviruses, influenza viruses, corona viruses,etc.)

(Should not be treated with antibiotics)

Treatment: rest and plenty of fluids, OTC cold, pain relievers.

- **Bacteria** (mainly Group A streptococcus, H. influenza)

Treatment: Antibiotics. The type depends on:

Type of bacteria

Sensitivity test

LRTI's(costly & more difficult to treat)

- **Bronchitis**(inflammation of major trachea& bronchi)

  Acute

  Chronic

  Acute exacerbation of chronic bronchitis

  Causes: viruses or bacteria(H. influenza,
  S. pneumonia& M. catarralis).

- **Pneumonia**(Serious infection of bronchioles & alveoli)

  Community -acquired(CAP)

  Hospital-acquired(nosocomial)

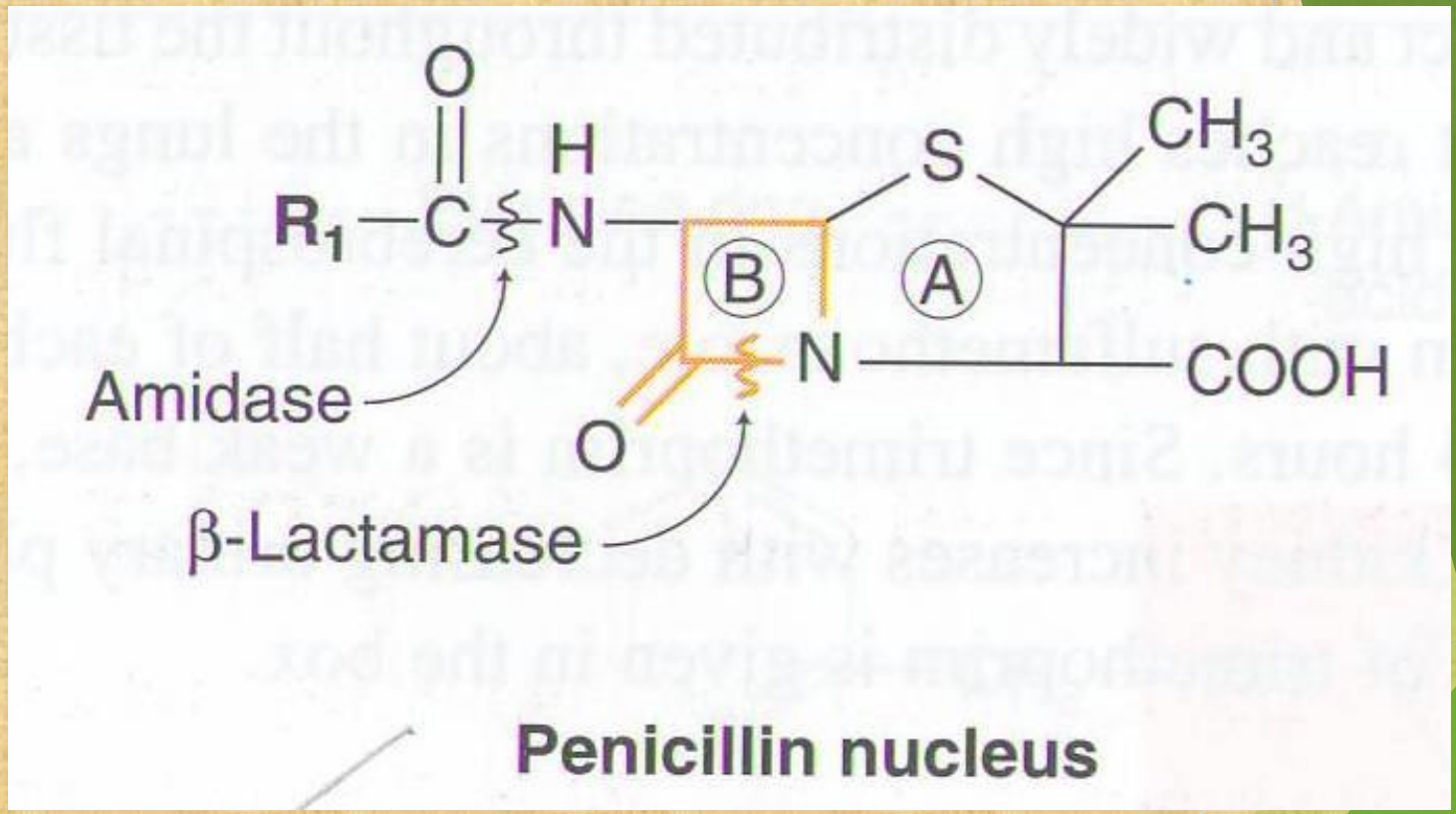
Causes:Bacteria

S.pneumonia**(66%),H.influenza(20%),M.catarrhalis (20%)

Antibiotics commonly used in the treatment of RTI's

- Beta lactam antibiotics (Penicillins / Cephalosporins)
- Macrolides
- Fluoroquinolones
- Tetracyclines
- Aminoglycosides

Penicillins



Penicillin nucleus

Mechanism of action of Penicillins

- Inhibits bacterial cell wall synthesis through inhibition of peptidoglycan layer of the cell wall.
- Bactericidal

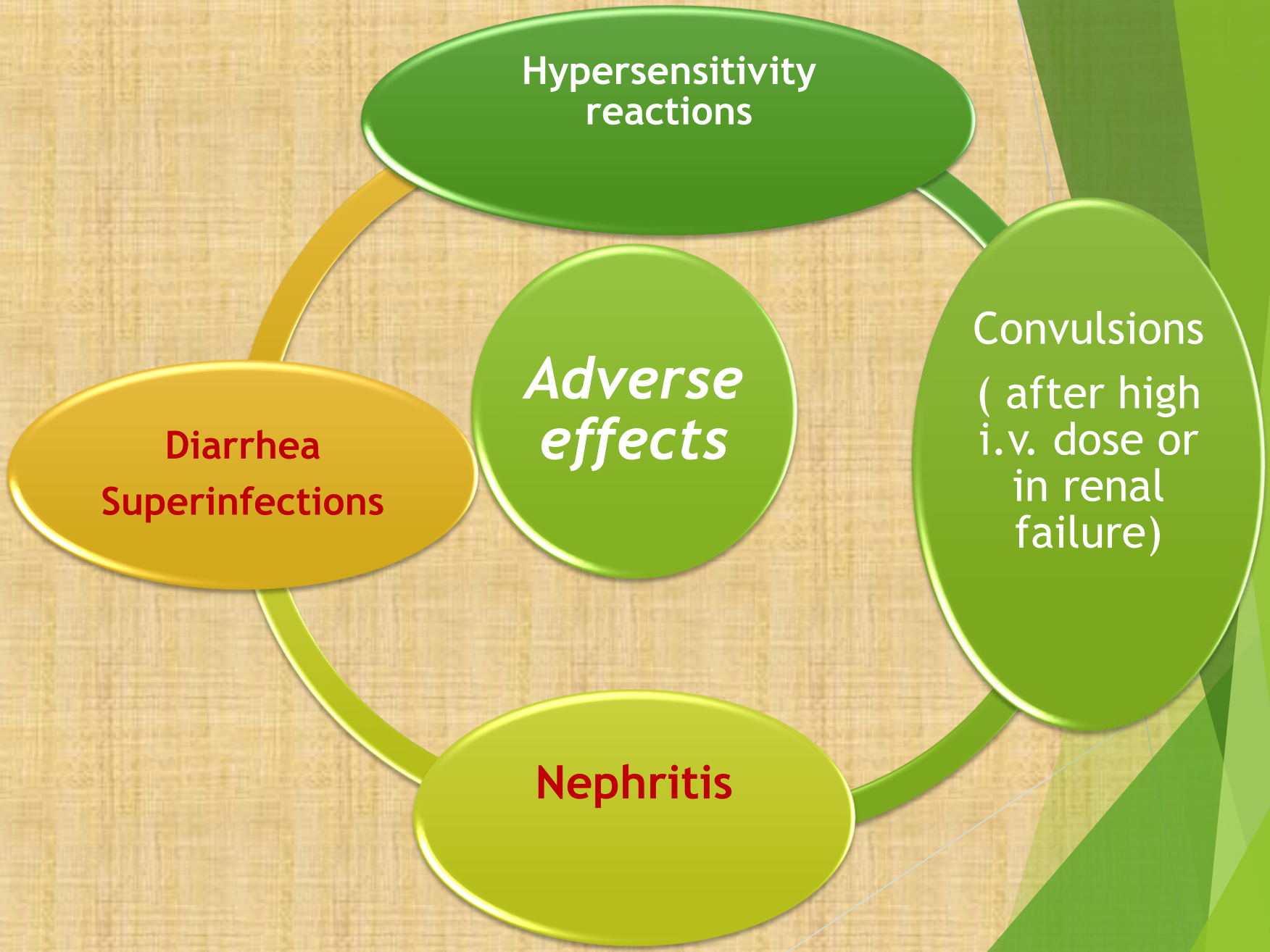
Pharmacokinetics of Penicillins

- Given orally or parenterally
- Not metabolized in human.
- Relatively lipid insoluble.
- Excreted mostly unchanged in urine(glomerular &tubular secretion).
- Probenecid slows their elimination and prolong their half live.
- Half-life 30-60 min(increased in renal failure).

Broad- spectrum penicillins

- Amoxicillin- Clavulanic acid
- Ampicillin- Sulbactam
- Piperacillin- tazobactam

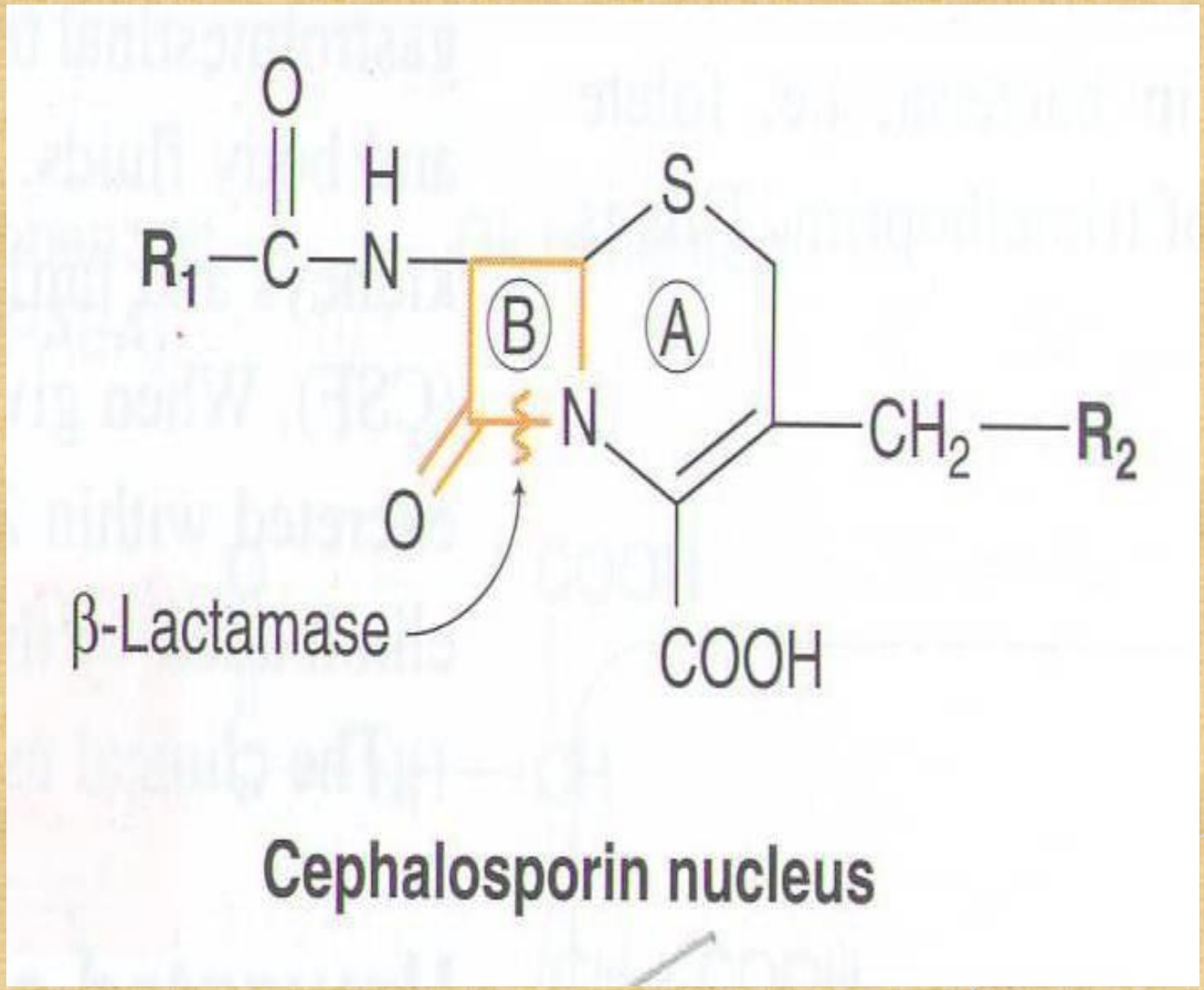
Act on both gram+ve & gram-ve microorganisms


Hypersensitivity reactions
Adverse effects
Convulsions (after high i.v. dose or in renal failure)
Nephritis
Diarrhea Superinfections

Therapeutic uses of Penicillins

- Upper respiratory tract infections
- Lower respiratory tract infections

Cephalosporins



Cephalosporin nucleus

Mechanism of action of Cephalosporins

- Inhibit bacterial cell wall synthesis
- Bactericidal

(Similar to Penicillins)

Pharmacokinetics of Cephalosporins

Given parenterally and orally.

Relatively lipid insoluble (like penicillins)

Mostly excreted unchanged by the kidney(glomerular & tubular secretion).

Probenecid slows their elimination and prolong their half live.

Half-life 30-90 min; except,ceftriaxone 4-7 hr

1st Generation Cephalosporins

- Cephalexin
  - Given orally
  - Effective against gram positive bacteria.
  - Effective in URTI's

2nd Generation Cephalosporins

Cefuroxime axetil , cefaclor

- Given orally
- Effective mainly against Gram-negative bacteria.
- Well absorbed orally
- Active against ß-lactamase -producing bacteria

Uses:

- Upper and lower respiratory tract infections

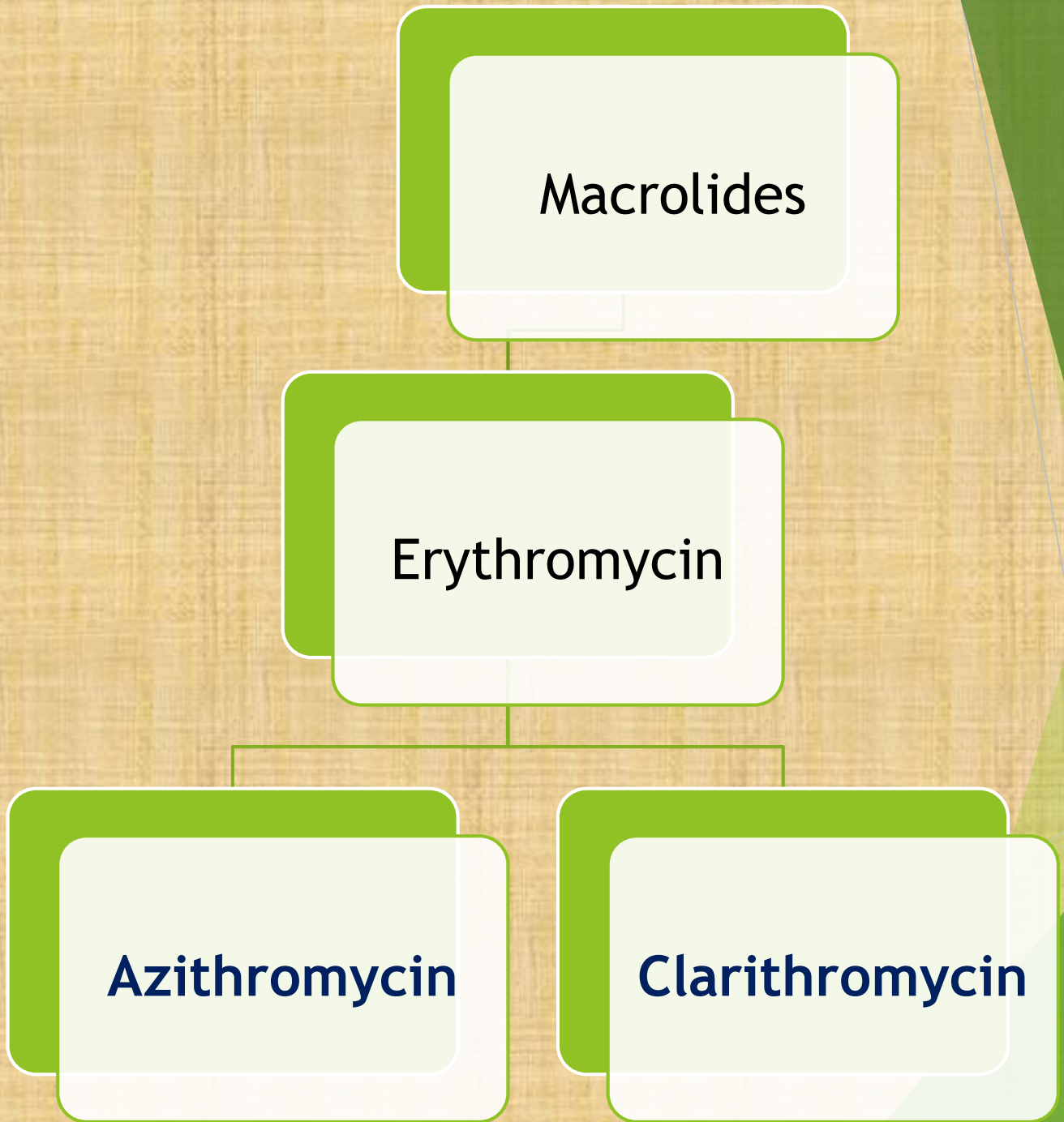
3rd Generation Cephalosporins

Ceftriaxone / Cefotaxime / Cefixime

- Given by intravenous route
- More effective against gram-negative bacilli
- Effective treatment in pneumonia

Adverse effects of cephalosporins

1. Hypersensitivity reactions
2. Thrombophilibitis
3. Superinfections
4. Diarrhea


Macrolides
Erythromycin
Azithromycin
Clarithromycin

Mechanism of action

Inhibit protein synthesis by binding to 50S subunit of the bacterial ribosomes

Bacteriostatic

Bactericidal at high concentrations

Clarithromycin

- More effective on G+ve bacteria.
- Stable at gastric acidity
- Inhibits cytochrome P450 system
- Metabolized to active metabolite
- Biliary route is the major route of elimination
- Only 10-15% excreted unchanged in the urine
- Half-life 6-8 hours

Azithromycin

- More effective on G-ve bacteria.
- Stable at gastric acidity
- Undergo some hepatic metabolism (inactive metabolite)
- Biliary route is the major route of elimination
- Only 10-15% excreted unchanged in the urine
- Half- life (3 days)
- Once daily dosing

No effect on cytochrome P- 450

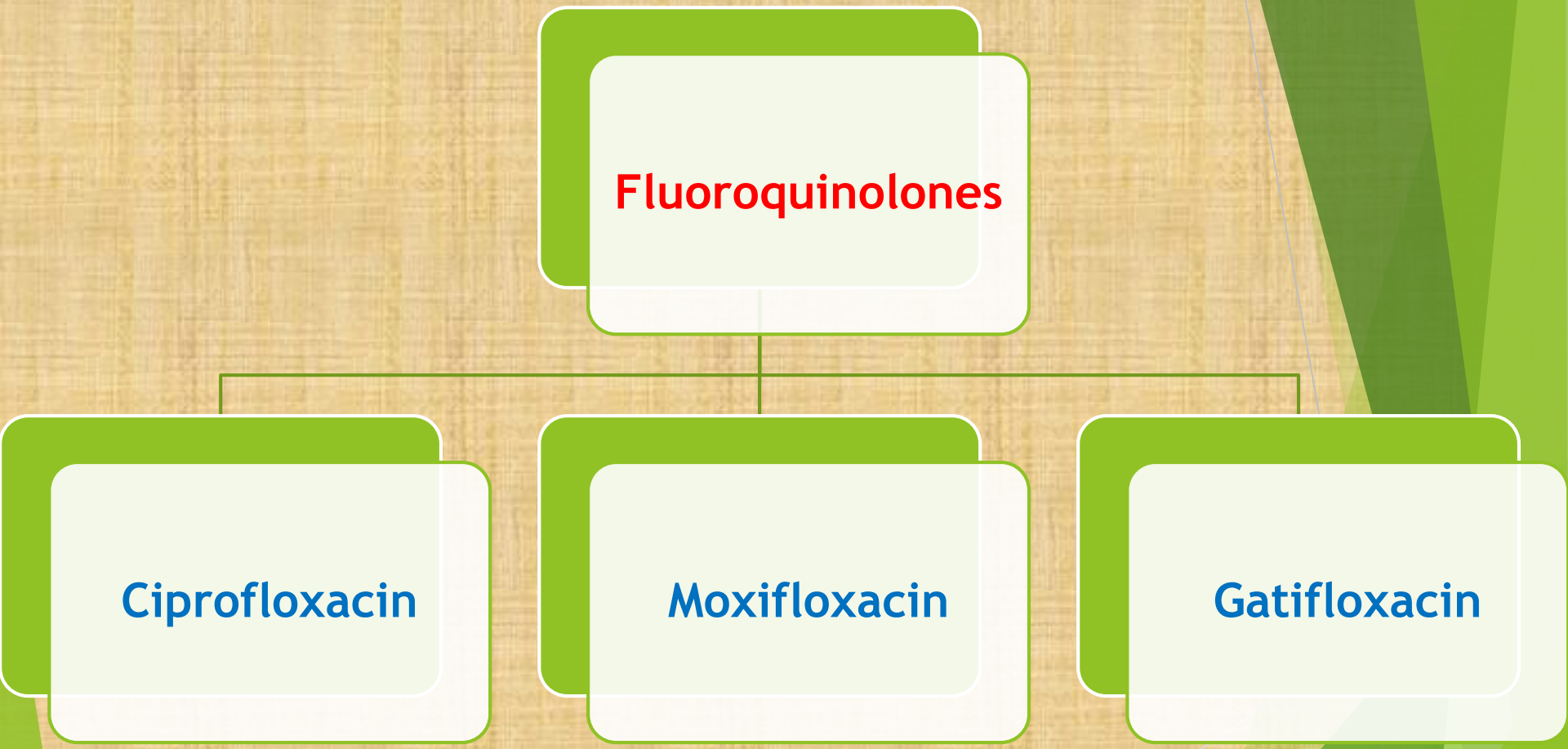
Clinical uses of Macrolides

- Chlamydial pneumonia
- Legionella pneumonia

Adverse effects

GI disturbances(nausea, vomiting,abdominal cramps &diarrhea.

Hypersensitivity reactions


Fluoroquinolones
Ciprofloxacin
Moxifloxacin
Gatifloxacin

Mechanism of action

Inhibit DNA Gyrase enzyme

(an enzyme involved in DNA supercoiling)

Antibacterial spectrum

Ciprofloxacin mainly effective against G – bacteria

Moxifloxacin & Gatifloxacin G – & G + & given once daily.

(highly active against Pseudomonas species)

Pharmacokinetics

- Given orally or parenterally.
- Di & tri-valent cations interfere with its absorption

- Concentrates in many tissues (kidney, prostate, lung & bones/ joints)

- Excreted mainly through the kidney

- Their relatively long Half-life allow once daily (moxifloxacin & Gatifloxacin) & twice-daily (ciprofloxacin) dosing.

Clinical Uses

- Acute exacerbation of chronic obstructive pulmonary disease
- Community acquired pneumonia
- Legionella pneumonia

Adverse effects

- Nausea , vomiting , diarrhea
- CNS effects (confusion, insomnia, headache, anxiety).
- Damage of growing cartilage(arthropathy)
- Phototoxicity(avoid excessive sunlight)

Contraindications

- Not recommended for patients younger than 18 years
- Pregnancy
- Breast feeding women

Tetracyclines (e.g. Doxycycline)

It is a long acting tetracycline

Mechanism of action

Inhibit protein synthesis by binding reversibly to 30 s subunit

Doxycycline (Cont.)

Pharmacokinetics

Usually given orally

Absorption is 90-100%

Absorbed in the upper s. intestine & best in absence of food

Food & di & tri-valent cations (Ca, Mg, Fe, AL) impair absorption

Protein binding 40-80 %

Distributed well, including CSF

Cross placenta and excreted in milk

Largely metabolized in the liver

Doxycycline (Cont.)

Side effects

1. nausea, vomiting ,diarrhea & epigastric pain(give with food)
2. Thrombophlebitis - i.v
3. Hepatic toxicity (prolonged therapy with high dose)
4. Brown discolouration of teeth - children
5. Deformity or growth inhibition of bones - children
6. Phototoxicity
7. Vertigo
8. Superinfections.

Contraindications of doxycycline

- Pregnancy
- Breast feeding
- Children(below 10 yrs)

Uses of Doxycycline

- Treatment of URTIs caused by S.pyogenes, S.pneumonia & H. influenza.

Aminoglycosides

e.g. GENTAMICIN,i.m,i.v.

- Bactericidal antibiotics
- Inhibits protein synthesis by binding to 30S ribosomal subunits.
- Poorly absorbed orally(highly charged).
- Only active against gram negative aerobic organisms.
- cross placenta.
- Excreted unchanged in urine

Gentamicin(CONT)

Adverse effects :

- Ototoxicity
- Nephrotoxicity
- Neuromuscular blocking effect

Therapeutic uses of Gentamicin

- Severe infections caused by gram negative organisms.

THANK YOU