Macrolides

Macrolides are a group of antibiotics whose activity stems from the presence of a macrolide lactone ring. Commonly used macrolides include erythromycin, azithromycin, and clarithromycin. As a class, these drugs bind to the 23S rRNA of the 50S prokaryotic ribosomal subunit and inhibit protein synthesis by blocking translocation. These antibiotics are considered to be bacteriostatic and are commonly used against gram-positive cocci, atypical pneumonias, and infections caused by Chlamydia. Bacteria can become resistant to macrolides via alteration of the 23S rRNA binding site, usually by post-transcriptional methylation.Macrolides are potent inhibitors of the cytochrome P450 system, especially CYP3A4. Therefore, macrolides can cause elevations of other drugs metabolized by the P450 system. One particular combination that should be avoided due to this interaction is macrolides with statins, used for lowering cholesterol, which can lead to debilitating myopathy. Macrolides, especially erythromycin and clarithromycin, also have an effect on QT prolongation, which can lead to torsade de pointes if untreated. These drugs exhibit enterohepatic recycling, meaning the drug is absorbed in the gut and sent to the liver, where it is excreted back into the duodenum in bile. This form of recycling can lead to a buildup of the product and cause nausea and GI distress like diarrhea. There is also a strong association between macrolides and hepatotoxicity. The pathogenesis of hepatotoxicity with macrolide exposure involves a direct cytotoxic effect and an immunoallergic reaction. Hepatoxicity caused by an immunoallergic reaction is typically accompanied by peripheral eosinophilia and skin rash.



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Mechanism of Action

Bacteriostatic
Bacteria-shocked
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Bind to 23S rRNA of 50S Subunit
23S rabbit-zombie-RNA-rhino with 50S rapper
Macrolides inhibit protein synthesis by interfering with the elongation of the polypeptide chain of bacterial proteins and the translocation of the ribosomal subunit. These antibiotics bind to the 23S ribosomal RNA in the 50S subunit, which catalyzes the formation of the peptide bond.

Inhibit Protein Synthesis by Blocking Translocation
Blocking Protein Train-loco
Macrolides inhibit protein synthesis by interfering with the elongation of the polypeptide chain of bacterial proteins and the translocation of the ribosomal subunit. These antibiotics bind to the 23S ribosomal RNA in the 50S subunit, which catalyzes the formation of the peptide bond.

Macrolides

Erythromycin
Earth-throw-mice
Erythromycin is a macrolide antibiotic with a spectrum similar to other macrolide drugs. It is first line for superficial ocular infections and Legionnaire's Disease. Erythromycin is especially associated with GI disturbances because it is a motilin agonist. Due to this, erythromycin is sometimes used to treat gastroparesis. It is also associated with prolonged QT intervals that can lead to Torsades.

Azithromycin
Zipper-mice
Azithromycin, commonly called Zithromax or Zmax, is a macrolide antibiotic derived from erythromycin. This drug is commonly used to treat respiratory bacterial infections though it is used either second-line or in patients with a -cillin allergy. It is also effective against sexually transmitted infections, including Chlamydia. Azithromycin has been associated with cardiovascular effects, specifically prolongation of the QT interval. Prolongation of the QT interval can lead to torsades de pointes (TdP), an abnormal heart rhythm that can be fatal.

Clarithromycin
Clarinet-mice
Clarithromycin is a macrolide antibiotic typically used to treat respiratory bacterial infections though it is used either second-line or in patients with a -cillin allergy. It is also used in acute exacerbations of chronic bronchitis, H. pylori infections and mycobacterium avium complex (MAC) prophylaxis in patients

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with HIV. Unlike erythromycin, clarithromycin is acid-stable and can be taken orally without being protected from gastric acids. Of all the drugs in its class, clarithromycin has the best bioavailability, which makes it more amenable to oral administration.

Indications

Gram-Positive Cocci

Graham-cracker Positive-angel with Cock-eyes

Gram-positive cocci are gram-positive organisms that absorb crystal violet on gram stain due to a thick peptidoglycan layer with a spherical shape. Gram-positive cocci include Staphylococcus and Streptococcus species. Macrolides are effective against gram-positive cocci.

Atypical Pneumonia

A-tipi X-ray Screen on Nude-Mona

Atypical pneumonias are typically characterized by a protracted course, lack of sputum production, and extra-pulmonary symptoms as compared to typical pneumonias. Common causes of atypical pneumonias include Mycoplasma pneumoniae, Chlamydia, and Legionella. Macrolide antibiotics are commonly used in the treatment of atypical pneumonias.

Chlamydia

Chlamydia-clam

Chlamydia trachomatis is an obligate intracellular human pathogen that has three human serovars that cause diseases, including trachomas, urethritis, and lymphogranuloma venereum. Macrolides can also be used to treat infections caused by Chlamydia pneumoniae and Chlamydia psittaci.

Considerations

Resistance by Methylation of 23S rRNA Binding

Methylated-CH3 Rhino wearing Resistance-bandana

Bacteria can become resistant to macrolides via alteration of the 23S rRNA binding site, usually by post-transcriptional methylation, a process of enzymatic modification of gene expression, RNA processing and impact on protein functioning.

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