Chloramphenicol

Chloramphenicol is a bacteriostatic antibiotic that binds to the 50S prokaryotic ribosomal subunit and inhibits peptidyltransferase activity. This drug is effective against a wide variety of gram positive and gram negative bacteria. However, due to resistance and safety concerns due to toxicities, it is no longer a first line agent for any infection in developed nations. However, it is both cheap and easy to manufacture and is still frequently used, especially in the treatment of meningitis, in developing countries. The most serious adverse effect associated with chloramphenicol is bone marrow toxicity which can occur in two distinct forms including bone marrow suppression causing anemia and aplastic anemia. IV chloramphenicol use is associated with gray baby syndrome, which occurs in newborns because they do not yet have fully functional liver enzymes including UDP glucuronyl transferase to metabolize chloramphenicol. This leads to severe adverse effects including cyanosis, discoloration of the baby to an ashen gray color, hypotension and cardiovascular collapse. Resistance to chloramphenicol is caused by an enzyme called chloramphenicol acetyltransferase, which inactivates chloamphenicol by covalently linking an acetyl group to a hydroxyl group on the chloramphenicol molecule. The acetylation prevents the drug from binding to the ribosome.

PLAY PICMONIC

Mechanism

Bacteriostatic

Bacteria-shocked

Bacteriostatic antibiotics limit the growth of bacteria by interfering with bacterial protein production, DNA replication, or other aspects of metabolism while not necessarily directly harming the organism. Upon removal of the bacteriostatic agent, the bacteria can regrow as opposed to bactericidal agents that directly kill bacteria.

Inhibits 50S Peptidyltransferase Activity

Inhibiting-chains on 50S-rapper with Pepti-transformer

Chloramphenicol prevents protein chain elongation via inhibition of peptidyltransferase activity of the 50S prokaryotic ribosomal subunit preventing peptide bond formation. Peptidyltransferase enzymes form peptide bonds between adjacent amino acids using tRNAs during the translation process of protein biosynthesis.

Indications

Meningitis

Men-in-tights

Chloramphenicol has excellent blood brain barrier penetration and is active against the three main bacterial causes of meningitis including Neisseria meningitidis, Streptococcus pneumoniae, and Haemophilus influenzae. In developed nations, it is only used when patients have a severe penicillin or cephalosporin allergy. However, in developing nations, it is commonly used to treat meningitis due to low cost.

Rocky Mountain Spotted Fever in Pregnant Women

Rocky Mountain Spotted Pregnant Fever-beaver

Chloramphenicol may be used to treat patients with rocky mountain spotted fever (RMSF). Though doxycycline is the drug of choice for treating RMSF, pregnant women may be treated with chloramphenicol as an alternative.

Side Effects

Anemia

Anemone

One of the most serious adverse effects associated with chloramphenicol treatment is bone marrow toxicity which can cause anemia. This is a direct toxic effect of the drug and is typically reversible.

Aplastic Anemia

A-plastic-bottle Anemone

Aplastic anemia is a condition characterized by insufficient production of new blood cells to replenish blood cells. Unlike anemia which refers to only low red blood cell counts, aplastic anemia refers to lower counts of all three blood types including red blood cells, white blood cells, and platelets. This side effect is rare and generally fatal.

Gray Baby Syndrome due to Decreased UDP-Glucuronyl Transferase

Gray baby and Down-arrow Upside-Down-Pineapple-cake with Glue-transformer

IV chloramphenicol use is associated with gray baby syndrome, which occurs in newborns because they do not yet have fully functional liver enzymes including UDP glucuronyl transferase to metabolize chloramphenicol. This leads to severe adverse effects including cyanosis, discoloration of the baby to an ashen gray color, hypotension and cardiovascular collapse.

Resistance Caused by Plasmid Encoded Acetyltransferase

Being Resisted by the Plasmid-rope of A-sea-gull-transformer

Resistance to chloramphenicol is caused by an enzyme called chloramphenicol acetyltransferase, which inactivates chloamphenicol by covalently linking an acetyl group to a hydroxyl group on the chloamphenicol molecule. The acetylation prevents the drug from binding to the ribosome.