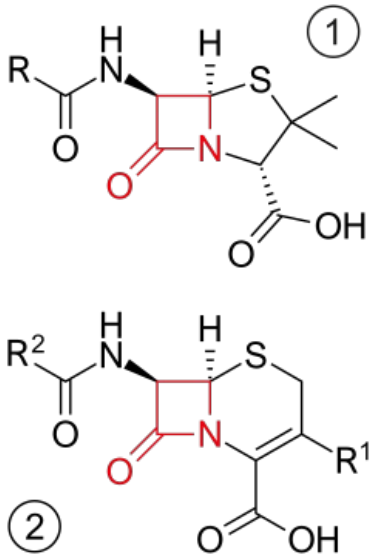
Beta lactam antibiotics

Beta-lactam antibiotics include penicillins, cephalosporins, monobactams and carbapenems. The last two groups belong to the so-called newer beta-lactams.[1]

Effect mechanism

A common feature for all groups is the presence of the *β-lactam ring* , which damages the cell wall of the bacteria, resulting in the death of the microorganism. They prevent the formation of a three-dimensional structure of the bacterial cell wall. This occurs through three mechanisms:

- penicillin-binding proteins (PBP);
- inhibition of cell wall synthesis by interrupting peptidoglycan transpeptidation (peptidoglycan is a polymer that imparts shape and stiffness to bacteria);
- activation of enzyme lytic agents on the cell wall.



β-lactam circle – 1) penicillins, 2) cephalosporines

At therapeutic concentrations, the effect is bactericidal. For penicillins and cephalosporins, bactericidal effect is restricted to cells with active peptidoglycan synthesis (ie, proliferating, in the growth phase). The different efficiency in G + and G− bacteria lies in the combination of different types of PBP proteins, the number of inactivating enzymes, the number of binding sites and the affinity for PBP.

Pharmacokinetics and Pharmacodynamics

Absorption from the GIT depends on the resistance to HCl. It can be reduced by eating at the same time, so it is advisable to take it at least 1 hour before meals. β-lactams are hydrophilic substances that "do not penetrate intracellularly", remain in the extracellular space, where they mimic plasma concentrations. Concentrations in the CNS are low, increasing with inflammatory meningeal changes. They are excreted by the kidneys, penetrating into the milk and sputum.

They have a "time-dependent effect", suggesting that high concentrations have the same effect as those just above minimum inhibitory concentration (MIC). For maximum effect, the concentration level above the MIC should be maintained for as long as possible.

Resistance

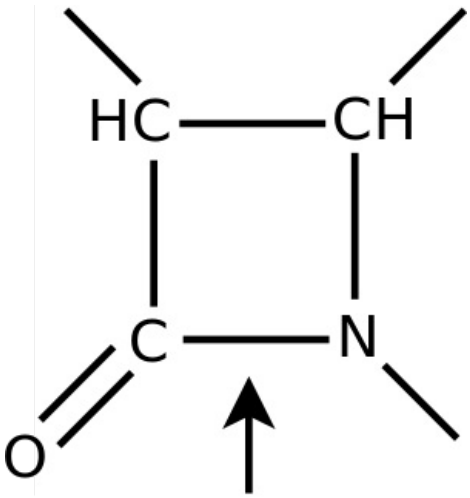
Enzymatic resistance

It involves the bacterial "production" of inactivating enzymes (beta-lactamases) that cleave the β-lactam ring.

Non-enzymatic resistance

'A change in the structure of PBP' , which causes the antibiotic not to recognize its receptor site and its affinity for the receptor to decrease. The change can occur either by modifying the binding site or by creating a new variant of PBP. We often encounter this type in MRSA.

Another possibility of developing resistance is the *'impermeability of the outer membrane'* (by reducing the number of porins). Antibiotics do not reach receptor sites. This type can be found exclusively in nosocomial multidrug-resistant G− microorganisms.



β-lactam ring - arrow shows the site of action of β-lactamases

There may be a lack of activation of autolytic enzymes in the bacterial cell wall. Thus, for example, staphylococci, streptococci, Listeria monocytogenes are inhibited, not destroyed.

Resistance also occurs through the formation of "efflux pumps" that are responsible for the active elimination of xenobiotics from the cell.

The development of secondary resistance is possible but slow.

Links

Source

- ws:Betalaktamová antibiotika

Related articles

- Antibiotics
- Beta-lactames inhibitors
- Penicillins
- Cephalosporines
- Monobactams
- Carbapenems

External links

- ß-Lactams: Mechanisms of Action and Resistance (video) (https://www.youtube.com/watch?v=qBdYnRhdWcQ)

References

1. MARTÍNKOVÁ, Jiřina – MIČUDA, Stanislav – CERMANOVÁ, Jolana. *www.lfhk.cuni.cz* [online]. [cit. 2010-05-23]. <https://www.lfhk.cuni.cz/farmakol/predn/prednbak.htm/>.

Used literature

- MARTÍNKOVÁ, Jiřina, et al. *Farmakologie pro studenty zdravotnických oborů.* 2. edition. Praha : Grada, 2018. ISBN 978-80-271-0929-6.
- ŠVIHOVEC, Jan, et al. *Farmakologie.* 1. edition. Praha : Grada, 2018. ISBN 978-80-271-2150-2.

Template:Navbox - ATB