# Beta-lactam antibiotics

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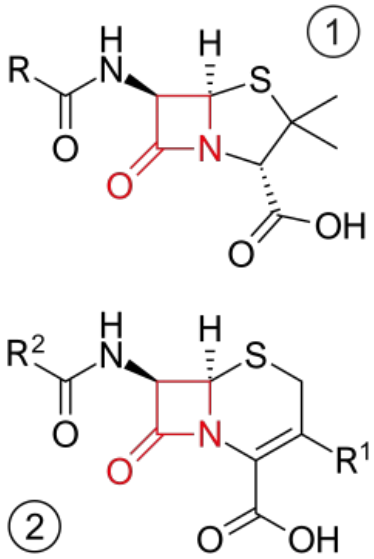
Beta-lactam antibiotics include penicillins, cephalosporins, monobactams and carbapenems. The last two groups belong to the so-called newer beta-lactams.[1]

## Mechanism of action

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

- binding to penicillin-binding proteins (*penicillin-binding proteins*, PBP);
- inhibition of cell wall synthesis by interrupting peptidoglycan transpeptidation u (peptidoglycan is a polymer that imparts shape and stiffness to bacteria);
- activation of enzymes that act lytically on the cell wall.



β-laktamový kruh – 1) penicillins, 2) cephalosporins

In therapeutic findings, the effect is bactericidal. For penicillins and cephalosporins, bactericide is restricted to cells with active peptidoglycan synthesis (ie, proliferating, in the growth phase). The different efficacy 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

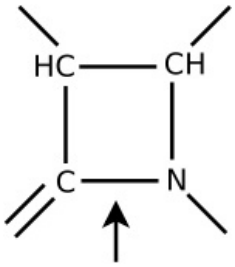
Absorption from the GIT depends on resistance to HCl. It can be reduced by eating at the same time, so take it at least 1 hour before a suitable meal. β-tamas are hydrophilic substances that **do not penetrate intracellularly**, they remain in the extracellular space, where they mimic plasma concentration. Concentrations in the CNS are low, we are looking for inflammatory meningeal changes. They are excreted by the kidneys, sold in milk and sputum.

It has **a time-dependent effect**, suggesting that high concentrations have an effect similar to those just above the MIC. For maximum effect, the concentration level should be kept above the MIC as long as possible.

## Resistance

### Enzymatic resistance

It rests in the bacterial **production of inactivating enzymes** (beta-lactamases), which cleave the β-lactam ring.



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

### Non-enzymatic resistance

**A change in the structure of PBP**, that causes an antibiotic not to recognize its receptor site and decreases its affinity for the receptor. The change can occur either by modifying the binding site or by creating new PBP variants. We often encounter this type at 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.

In the bacterial cell wall, there may be **a lack of activation of autolytic enzymes.** Thus, for example staphylococci, streptococci, listeria are inhibited, not destroyed.

Resistance also occurs through the formation of **efflux pumps**, which are responsible for the active elimination of xenobiotics from cells.

The development of secondary resistance is possible but slow.

# Links

## Related articles

- Antibiotics
- Beta-lactamase inhibitors
- Penicillins
- Cephalosporins
- 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. *Vybrané kapitoly z klinické farmakologie pro bakalářské studium* [online]. [cit. 2010-05-23]. <https://www.lfhk.cuni.cz/farmakol/predn/prednbak.htm/>.


## Bibliography


- 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.