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Antibiotics and Its Use

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Abstract

Antibiotics are chemical compounds produced by living bacteria or manufactured. Antibiotics are mainly used to treat the disease in humans and animals. They kill bacteria or prevent their growth. Most antibiotics are produced by bacteria or fungi in the soil. Antibiotics control the uncontrolled growth of bacteria in the soil. An antibiotic kills bacteria selectively. Antibiotics have a narrow or broad-spectrum antimicrobial activity. Antibiotics can kill the bacteria or prevent their growth by affecting cell walls, destroying cell membranes and interfering with chemical processes in bacterial cells. Irrational use of antibiotics may lead to toxicity, development of antibiotic resistance, untoward reactions or even death also. The antibiotic sensitivity test is essential for the effective and rational use of antibiotics.

Introduction

Antibiotics are drugs that kill pathogenic bacteria without harming the body's cells. Antibiotics are also useful in diseases caused by fungal and protozoan infections, as well as some cancers. The use of antibiotics has reduced the incidence and mortality of diseases such as encephalitis, pneumonia, tuberculosis, etc., But, they are not very effective against cold, flu or other viral diseases. Antibiotics only affect diseased cells. Their effects on other cells are less harmful. Antibiotics are also used to treat infectious diseases in animals.

Alexander Fleming, a scientist from England, noticed in 1929 that the invasive growth of the fungus Penicillium notatum stunted the growth of bacteria of the genus Streptococcus. Ten years later, Ernst Boris Chen (England) and Howard Walter Florey (Australia) isolated penicillin from fungi showing that the compound kills bacteria. It was named penicillin because it was produced from the Penicillium fungus. Fleming and Chen and Florey were awarded the 1945 Nobel Prize in Medicine for discovering this antibiotic. After that, various antibiotics were made by making many changes in the molecular formula

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of penicillin. Using these antibiotics made it possible to treat many diseases that cause staphylococcus, streptococcus, pneumococcus and syphilis.

Antibiotics, in particular, selectively kill bacteria. A key difference between bacterial and animal cells is that bacterial cells have a cell wall. The cell walls of different bacteria determine which antibiotics will kill those bacteria. Gram's staining method is used to classify bacteria according to their cell wall. In this process, the presence or absence of peptidoglycan in the bacterial cell wall is tested by crystal violet dye. The peptidoglycan compound makes the cell wall of bacteria strong. Bacteria with peptidoglycan in their cell wall do not change the color of crystal violet in their presence. Such bacteria are called gram-positive bacteria. Bacteria that cause crystal violet to become colorless are called gram-negative bacteria.

Some antibiotics selectively kill Gram-positive or Gram-negative bacteria. Such antibiotics are called short-acting antibiotics. For example, vancomycin antibiotics kill Gram-positive bacteria of the species Staphylococcus, Streptococcus, Enterococcus, etc. Also, gentamicin antibiotic mainly kills Gram-negative bacteria of the genus Pseudomonas, Proteus, Serratia, etc., e.g., tetracycline, and chloromphenicol. However, no broad-spectrum antibiotic kills all bacteria. Some antibiotics are useful against infections caused by fungi and protozoa. Cells of fungi and protozoa are also different from human cells. Antibiotics miconazole and amphotericin are used against fungal infections, while paramomycin is an antibiotic used against amoebic intestinal disorders (amoebiasis) caused by protozoa.

Doxorubicin is an antibiotic used to treat leukemia, breast cancer, and other tumors. This drug kills cancer cells as they divide. Since blood cells divide like cancerous cells, these antibiotics are likely to adversely affect blood cells.

Mechanism of action

Antibiotics fight disease in different ways. (1) Some antibiotics only affect the cell wall of bacteria. Compounds required for cell wall formation are made in bacterial cells. These compounds move out of the cell and combine to form the cell wall. In this type, antibiotics interfere with cell wall formation at different stages. Bacteria die due to a lack of cell wall, e.g., Penicillin, Cephalosporin, Cyclosterane, Vancomycin, etc. Antibiotics do not affect human cells because they do not have a cell wall. (2) All cells have a membrane around the cell membrane formation. This cell membrane regulates substances entering or leaving

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the cell. Some antibiotics destroy the cell membrane of certain bacteria. Due to the cell membrane's damage, the bacterial cells' vital components escape from the cell or toxic substances enter their cells. e.g., amphotericin, nystatin, etc. (3) All cells produce proteins and nucleic acids to survive. Bacterial cells also produce substances like human cells. But there are some differences between these processes. Some antibiotics only interfere with chemical processes in bacterial cells without interfering with chemical processes in human cells. For example, the antibiotics streptomycin and tetracycline stop protein synthesis in certain bacteria, while the antibiotic rifampin stops the production of nucleic acids in some bacteria.

Side Effects of Antibiotics:

Antibiotics have to be used carefully and in appropriate doses. Otherwise, its side effects also occur and in rare cases the patient may die. Side effects of antibiotics include: (1) Antibiotics cause hypersensitivity in some patients. Due to this, symptoms like rash and fever appear on the patient's body. Almost all antibiotics can cause hypersensitivity. However, the use of penicillin increases this possibility. That is why doctors ensure that the patient has antibiotic resistance. If a patient is allergic to a particular antibiotic, the doctor prescribes an antibiotic with the same properties but a different chemical composition. (2) Human body contains some harmless and some harmful bacteria. Both these types of bacteria compete for food. Therefore, the number of harmful bacteria is controlled by the harmless bacteria. Many antibiotics, especially broad-spectrum antibiotics, do not always distinguish between harmless and harmful bacteria. Harmless bacteria are killed in excess, while harmful bacteria grow out of proportion. They cause new infections and become highly contagious. Doctors prescribe antibiotics such as Lactobacillus along with probiotics to combat this condition. (3) Antibiotics used only to kill pathogenic bacteria are less likely to cause organ and tissue damage. However, some antibiotics can cause organ and tissue damage if used excessively and for long periods. For example, overuse of streptomycin can cause kidney failure or deafness. So if no other antibiotics are effective, doctors use these antibiotics. Cancer antibiotics work against all cells that divide rapidly. It can also affect healthy cells. For example, in the bone marrow, cell division constantly forms new cells. Antibiotics affect the hematopoietic cells in the bone marrow, causing a decrease in the white blood cell count, and the patient may be susceptible to even minor infections.

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Bacterial resistance to antibiotics:

Some pathogenic bacteria can develop resistance to antibiotics. Like other living organisms, bacteria also have genes that control life processes. Sometimes, naturally occurring mutations occur in the genes of bacteria that make them resistant to antibiotics. They create resistance by producing antibodies that break down the antibiotic molecules. This occurs in staphylococcus bacteria and is resistant to penicillin and cephalosporin antibiotics. Some bacteria's cell membrane is changed so that antibiotics cannot enter their cells. Pseudomonas species are resistant to quinolane antibiotics in this way. Proteins in Enterococcus species are altered so that the vancomycin antibiotic that affects them is ineffective.

Antibiotic tests:

For the effective use of antibiotics in the treatment, carrying out an antibiotic sensitivity test is essential. Scientists regularly perform tests to see which antibiotics are effective against which bacteria. Antibiotics that cure disease through such tests are used as antibiotics. Because this method is time-consuming, broad-spectrum antibiotics are often used. Penicillin is considered the safest antibiotic. Two types of penicillin are currently available: naturally occurring and man-made. Natural penicillin is used for throat infections, syphilis and encephalitis. Cephalosporins are also man-made and four generations have been produced. First-generation cephalosporins are effective against penicillin-resistant pneumococcus bacteria. Man-made antibiotics such as penicillin and clinolone can be taken orally in pill form, while some are given by injection.

Conclusion

An antibiotic sensitivity test could be an effective tool for the rational and effective use of antibiotics in the treatment of human and animals.

References

Hutchings, M. I., Truman, A. W. and Wilkinson, B. (2019). Antibiotics: past, present and future.Current Opinion in Microbiology, 51:72-80.

Kırmusaoğlu, S., Gareayaghi, N., and S. Kocazeybek, B. (2019). Introductory Chapter: The Action Mechanisms of Antibiotics and Antibiotic Resistance. Intech Open. doi: 10.5772/intechopen.85211.

Mohsen, S., Dickinson, J. A., & Somayaji, R. (2020). Update on the adverse effects of antimicrobial therapies in community practice. Canadian family physician Medecin de famille canadien, 66(9): 651–659.

Ramirez, J., Guarner, F., Bustos Fernandez, L., Maruy, A., Sdepanian, V. L., and Cohen, H. (2020). Antibiotics as Major Disruptors of Gut Microbiota. Frontiers in Cellular and Infection Microbiology, 10. https://doi.org/10.3389/fcimb.2020.572912.