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A Review on Antibiotics as Drug and Poison

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Abstract:
Antibiotics are powerful medicines that treat certain infections and, when used correctly, can save lives. They either prevent the growth of bacteria or destroy them. Normally, the immune system can kill bacteria before they can multiply and cause symptoms. White blood cells (WBC) attack harmful bacteria. Even when symptoms appear, the immune system is usually able to manage and fight off the infection. However, there are times when the number of harmful bacteria is too large for the immune system to eliminate them all. Antibiotics can help in this scenario. The first antibiotic was penicillin. Penicillin-based antibiotics such as ampicillin, amoxicillin, and penicillin G are still available and have been used for many years to treat a variety of infections. There are several types of modern antibiotics that are usually available only by prescription in the United States. Topical antibiotics are available in over-the-counter (OTC) creams and ointments. Modern medicine has changed as a result of antibiotics. They facilitate critical therapies and procedures and are crucial for the treatment of infectious disorders. Nevertheless, despite their popularity, their continued usage in the twenty-first century is threatened by two unrelated problems. The first is that over time, the bacteria that these medications are meant to kill develop a tolerance to them. The second is that traditional mechanisms of payment are no longer cost-effective for discovering and developing antibiotics. As a result, there are fewer businesses and research facilities focused on producing new antibiotics, creating a pipeline that is anemic and endangers our ability to control diseases.

Keywords: Penicillin, microorganism, bacteria, drugs, resistance.

INTRODUCTION

An antibiotic is a type of antimicrobial substance active against bacteria. It is the most important type of antibacterial agent for fighting bacterial infections[1]. Antibiotics are not effective against viruses such as the common cold or influenza; drugs that inhibit viruses are termed antiviral drugs or antivirals rather than antibiotics.[2] Sometimes, the term antibiotic—literally "opposing life", from the Greek roots ἀντι anti, "against" and βίος bios, "life"—is broadly used to refer to any substance used against microbes[3]. "Antibacterial agents" include antiseptics, antibacterial soaps and chemical disinfectants, but antibiotics are an important class of antibacterial agents used more specifically in medicine and sometimes in animal feed. Many civilizations utilized the topical application of moldy bread, with many references to its beneficial effects from ancient Egypt, Nubia, China, Serbia, Greece, and Rome. The first person to document the use of mold directly was John Parkinson (1567–1650).[4] Alexander Fleming (1881–1955) discovered modern penicillin in 1928. The widespread use of penicillin proved very beneficial during the war. However, the availability and easy access of antibiotics has also led to their overuse, and some bacteria have developed resistance to them.[5]

History of Antibiotics

Over 2,000 years ago, mixtures having antibacterial characteristics that were used to treat infections were documented.[6] Infections were treated with carefully chosen mold and plant components by many ancient cultures, including the ancient Egyptians and the ancient Greeks.[7] Tetracycline in Nubian mummies was found to be present in large amounts during 1990s research.

A. Synthetic antibiotics derived from dyes:

Paul Ehrlich developed the science of synthetic antibiotic chemotherapy and the creation of antibacterials in Germany in the late 1880s.[8] In 1907, Ehrlich found the first synthetic antibacterial organoarsenic chemical salvarsan. This signaled the start of the antibacterial era that Alfred Bertheim and Ehrlich had initiated in 1907 with the discovery of a number of synthetic antibiotics derived from arsenic.[9] Ehrlich and Bertheim had experimented with a variety of compounds derived from dyes to treat Spirochaeta infection in rabbits and trypanosomiasis in mice. Ehrlich and Sahachiro Hata, a Japanese bacteriologist who collaborated with Ehrlich in the search for a medicine to treat syphilis, had success with their 606th compound after their initial compounds proved to be too toxic.[10] Prontosil was created in 1932 or 1933 by a research team under the direction of Gerhard Domagk at the Bayer Laboratories of the IG Farben corporation in Germany. Since sulfanilamide, the substance that makes up Prontosil, had been utilized in the dye industry for some time, it was not patentable. Protosil had a rather broad effect on gram-positive cocci. Its success quickly sparked more research.[11]

B. Penicillin and other natural antibiotics:

Sir William Roberts, a physician, observed in 1874 that cultures of the mold Penicillium glaucum, which is used to make some varieties of blue cheese, did not exhibit bacterial contamination. John Tyndall, a physicist, made a contribution to this area in 1876. In a research he published in 1895, Italian physician Vincenzo Tiberio discussed the antibacterial effects of several mold extracts.[12] Sir Alexander Fleming proposed the discovery of penicillin in 1928. Penicillin is a chemical produced by specific molds that either kills or inhibits the growth of specific types of bacteria.[13] In 1928, Fleming proposed that the mold must exude penicillin, an antibiotic agent. Fleming thought that chemotherapy may make use of its antibacterial qualities.[14] The first penicillin, penicillin G, was successfully purified in 1942 by Ernst Chain, Howard Florey, and Edward Abraham; nonetheless, it took until 1945 for it to become generally accessible outside of the Allied military. Later, Norman Heatley created the back extraction process to effectively purify penicillin in large quantities. Abraham originally suggested the molecular structure of penicillin in 1942, and Dorothy Crowfoot Hodgkin later validated it in 1945.[15] The discovery of penicillin sparked a resurgence in interest in the pursuit of safe and effective antibiotic chemicals. René Dubos, according to Florey, invented the method of purposefully and methodically looking for antibacterial chemicals, which resulted in the discovery of gramicidin and rekindled Florey's penicillin research.[16] Dubos reported the discovery of the first naturally produced antibiotic, tyrothricin, a mixture of 20% gramicidin and 80% tyrocidine, from Bacillus brevis in 1939, which also happened to be the beginning of World War II. Gramicidin, however, was poisonous and could not be administered systemically. For systemic use, tyrocidine likewise found to be excessively toxic. During World War II, the Axis and Allied governments did not exchange research findings from that time and limited access during the cold war. [17]

C. Late 20th century

The number of new antibiotic compounds used in medicine considerably grew in the middle of the 20th century. There were 12 new classes introduced between 1935 and 1968. But after then, there were significantly fewer new classes added, with only two new classes added between 1969 and 2003.[18]

PRESENT BENEFITS OF ANTIBIOTICS

In the Present World, there are various types of antibiotics available that are used for various purposes and have various uses and benefits. Following are some types of antibiotics and their uses.

A. Penicillins: The first penicillin gave rise to an entire class of antibiotics known as penicillins. Penicillins are a type of antibiotic derived from Penicillium fungi. An antibiotic is a type of medicine that inhibits the growth of, or kills, bacteria.[29] Penicillins may be used to treat a wide range of infections caused by susceptible bacteria, such as Dental abscesses, Ear infections (eg, otitis media), Gonorrhoea, Pneumonia, Respiratory tract infections, Rheumatic fever, Scarlet fever, Skin infections, Urinary tract infections.

Today in the market there are different types of penicillins available with various uses such as aminopenicillin, antipseudomonal penicillins, beta-lactamase Inhibitors, natural penicillins etc.[20]

B. Cephalosporins: A broad class of antibiotics called cephalosporins was produced from the mold Acremonium (previously called Cephalosporium). Similar to penicillins, cephalosporins are bactericidal (kill bacteria). They attach to and inhibit the activity of the enzymes that produce peptidoglycan, a crucial element of the bacterial cell wall. Because they work against a variety of bacteria, they are known as broad-spectrum antibiotics.[21]

C. Macrolides: Macrolides are a subclass of antibiotics generated from the soil-borne bacteria Saccharopolyspora erythraea (formerly known as Streptomyces erythreus). By reversibly interacting with the P site of the 50S unit of the ribosome, macrolides prevent bacteria from producing protein. Gram-positive cocci and intracellular pathogens including mycoplasma, chlamydia, and legionella are the principal targets of macrolides. The first macrolide was erythromycin; others were clarithromycin, azithromycin, and roxithromycin.[22]

D. Quinolones(broad-spectrum antibiotics): An example of an antibiotic is an uinolone. Bacterial growth is either stopped or killed by antibiotics. Quinolones fall into five main classes. In addition, quinolones were used to create the fluoroquinolone class of antibiotics by adding fluorine to their structure. There are numerous similarities between quinolones and fluoroquinolones, but there are also some differences, such as the types of organisms they are effective against. Some people interchangeably use the terms quinolones and fluoroquinolones.[23]

E. Sulfonamides: Sulfonamides, also known as sulphonamides, are a class of synthetic (man-made) medications that include the sulfonamide chemical group. They could also go by the name sulfa medicines. Sulfonamides are frequently used in imprecise terms to describe just antibiotics with a sulfonamide functional group in their chemical structure. However, a number of non-antibiotic sulfonamides have been created by utilising findings from the clinical assessment of the antibiotic sulfonamides.[24]

F. Tetracycline: A group of antibiotics known as tetracyclines can be used to treat infections brought on by microorganisms like gram-positive and gram-negative bacteria, chlamydiae, mycoplasma, protozoans, or rickettsiae.The first tetracyclines, which were found in the 1940s, came from Streptomyces bacteria or were developed from them. Tetracyclines impede the microbial RNA's ability to synthesize proteins (an important molecule that acts as a messenger for DNA). Since they are largely bacteriostatic, they don't always kill the germs; rather, they stop them from growing.Tetracyclines are still frequently used in both human and veterinary medicine, but bacterial resistance has significantly reduced their efficacy and is a serious concern.[25]

G. **Other Types of Antibiotics:**If none of the above classes of antibiotics are successful, doctors have a variety of other options. Some of them are only available in a hospital.Others are just too useful to be included in the primary groups. This includes antibiotics including nitrofurantoin, clindamycin, and metronidazole (Flagyl) (Furadantin, Macrodantin).

SIDE EFFECTS (LIKE POISON)

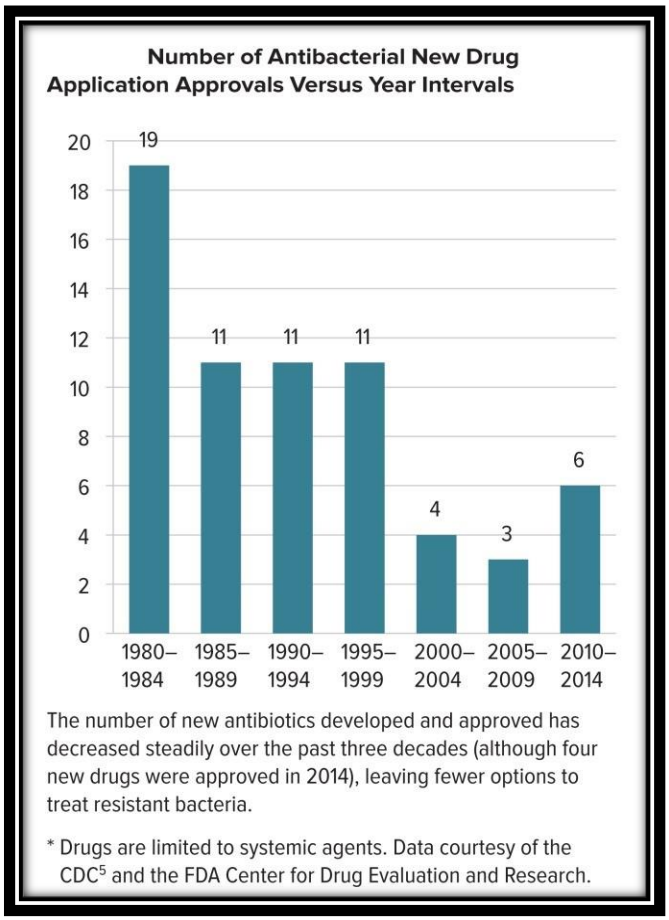
From Above Point It can be said that Antibiotics are Helpful against Infections, inhibiting and killing bacterias but Overuse of Them Can be harmful and may cause various side effects.[26] Antibiotics commonly cause side effects such as diarrhea, nausea, vomiting, rash, upset stomach sensitivity to sunlight, when taking tetracyclines, with certain antibiotics or prolonged use, fungal infections of the mouth, digestive tract, and vagina.

Other than Above Side Effects following are The Major Side Effects of Antibiotics

A. **Allergic reactions**: An increasing number of people attend the emergency room each year due to antibiotic responses. Nearly four out of every five trips to the emergency room for antibiotic-related side effects are brought on by an allergic reaction. These reactions can range in severity from minor rashes and itching to painful, blistering skin reactions, facial and throat swelling, and breathing difficulties. The greatest method to lower the risk of antibiotic side effects is to minimize needless antibiotic use. People should disclose to their doctor any sensitivities or prior drug reactions .[27]

B. **Difficile:** Diarrhea brought on by the bacteria (germ) C. difficile is responsible for at least 14,000 annual American fatalities. When you take antibiotics, the beneficial bacteria that fight infections are killed for a while. During this time, C. difficile infection is possible. The germs can spread from the medical setting or be picked up from contaminated surfaces. People who use antibiotics and receive medical care are most at risk, especially elderly adults. Antibiotics should only be taken exactly as directed.[28]

C. **Antibiotic Resistance:** Medicines known as antibiotics are used to both prevent and treat bacterial infections. When bacteria adapt to the use of antibiotics, antibiotic resistance develops. Antibiotic resistance develops in bacteria, not in people or other animals. Both humans and animals are susceptible to infection from these germs, and their infections are more difficult to treat than those brought on by non-resistant bacteria.Antibiotic resistance causes increased mortality, longer hospital stays, and higher medical expenses.



Are Antibiotics Safe?

Now From all the above points, the question arises is - Are Antibiotics good for health ? Simple answer to the question is Yes, they are safe as long as someone doesn't misuse them.Antibiotics can save lives, they fight bacteria and can cure life-threatening infectious diseases such as pneumonia, for which there was previously no effective treatment. But the improper use of antibiotics means that more and more bacteria are becoming resistant to this kind of medication. So it is especially important to use them correctly.

Future of Antibiotics

The World Economic Forum (WEF) recently released its annual report on global risks, which stated that "probably the greatest risk to human health comes in the form of antibiotic-resistant microorganisms. We inhabit a bacterial universe in which it is impossible for us to remain ahead of the mutational curve. How far behind the curve we allow ourselves to fall is a measure of our resilience. The cornerstones of society's strategy for battling resistance are traditional practices in infection control, antibiotic stewardship, and novel antibiotic development and they must be maintained. But despite our continuous efforts on all of these fronts, the WEF study highlights the fact that antibiotic resistance and the breakdown of the pipeline for developing new antibiotics are still becoming worse. We will require fresh ideas to supplement established methods if we

are to construct effective defenses.[29] New methods that are founded on a rethinking of the nature of disease, resistance, and prevention are required.

Precautions

Antibiotics can have negative side effects and increase antibiotic resistance, so you should only use them when necessary. The development of microorganisms that can withstand an antibiotic's effects is known as antibiotic resistance. As long as your doctor has recommended them, antibiotics must be taken. Even while the illness's symptoms may lessen, not all of the bacteria have necessarily been eradicated. The sickness could relapse if bacteria are still present. If there are any extra tablets, they shouldn't be stored for later use or distributed to others. You can either drop off leftover medication at some pharmacies or dispose of it in the regular trash. However, pharmacies are not required to take unsealed medications. It's crucial not to flush or pour the medication down the toilet when getting rid of it. That harms the ecosystem and fuels the development of bacterial resistance.

Conclusion

Antibiotics are essential for medical use in various medical procedures and are effective against various types of bacterias. The effects of antibiotics depend on their uses. If one takes them as prescribed and in limited quantities they can be very helpful for fighting against diseases and can be beneficial for human beings. But if one takes them without any precautions and misuse them and use them carelessly then antibiotics can be poisonous. Also some antibiotics can cause side effects but they can be treated as long as they are used safely. One of the major problems in antibiotics is antibiotic resistance which is caused by overuse of them. Hence, Antibiotics should be used as prescribed by doctors and one should follow all the precautions mentioned for their own benefits. The ways we have developed, used, and protected antibiotics have led, predictably, to our current crisis of rising antibiotic resistance and declining new treatments. If we want to stave off a post antibiotic era, we need to fundamentally change our approach. We need to challenge long-standing assumptions and cherished beliefs. We need to push through the reflexive resistance and excuses (eg, “that's not how we do things” and “that can't be done”) that result from challenging established ways. Excuses abound. Action is needed. Ultimately, we need a coordinated national action plan to combat resistance.

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