

History

Antibacterial agents in the cinema

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SUMMARY

Numerous procedures used as antibacterial therapy are present in many films and include strategies ranging from different antimicrobial drugs to surgery and supporting measures. Films also explore the correct use and misuse of antimicrobial agents. Side effects and other aspects related to antibacterial therapy have also been reflected in some films. This article refers to the presence of antibacterial agents in different popular movies. There are movies in which antibacterial agents form part of the central plot, while in others it is merely an important part of the plot. In still others, its presence is isolated, and in these it plays an ambient or anecdotal role.

Key words: Cinema - Antibacterial therapy - Antimicrobial agents

Agentes antibacterianos en el cine

RESUMEN

En muchas películas aparecen numerosos procedimientos utilizados como tratamiento antibacteriano, desde la aparición de distintos fármacos hasta procedimientos quirúrgicos y medidas de soporte. Las películas también exploran la utilización correcta y el abuso de agentes antimicrobianos, y en algunas de ellas aparecen reflejados también sus efectos adversos y otros aspectos relativos al tratamiento antibacteriano. Este artículo hace referencia a la presencia de agentes antibacterianos en distintas películas famosas. En algunas de estas películas, los agentes antibacterianos forman parte del argumento central de la historia, mientras que en otras son una parte importante, aunque no central, y en otras su presencia es sólo anecdótica.

Palabras clave: Cine - Terapia antibacteriana - Agentes antimicrobianos

INTRODUCTION

The Spanish philosopher José Ortega y Gasset affirmed that “man is himself and his own circumstances” (1). Diseases are adverse circumstances that affect people’s lives. A superficial analysis reveals that in many movies diverse infectious diseases are present (2, 3). One of the greatest achievements in medicine in the last century was the discovery and development of antibacterial agents, which have contributed significantly to the control of many infectious diseases and to a reduction in the mortality attributed to them. It seems appropriate to try to identify what the presence of these agents in the treatment and prevention of infectious diseases has signified in movies. It is important for health professionals to be aware of the impact of these agents in the media and to apply it to professional practice.

THE ORIGIN OF CHEMOTHERAPY

The greatest movie about chemotherapy is *Dr. Ehrlich’s Magic Bullet* (1940). The film very truthfully tells the life of German scientist Paul Ehrlich. The story begins just shortly before he meets Robert Koch and continues until his discovery of salvarsan as a treatment for syphilis. The plot links aspects of his personal life and his scientific contributions. For example, it depicts his interest in dyes; his method of staining the tuberculosis bacillus; his work with Koch; his journey to Egypt to investigate snake venom antiserum; and, coincidentally, the cure of his own tuberculosis thanks to the country’s climate; the formulation of the side chain theory, for which the 1908 Nobel Prize award in Physiology or Medicine validated his work;

and his collaboration with Emil von Behring. Nevertheless, the most important part of the plot, which adequately captures the title of the film, was undoubtedly the formulation of the fundamental principle of antiinfective chemotherapy: selective toxicity or “magic bullet”. This emerges at the end of the story, when Ehrlich obtained compound 606, a relatively nontoxic antimicrobial agent effective in the treatment of syphilis. The principle of selective toxicity was based on his knowledge of the differential staining of tissues. Furthermore, the movie also proposes that there were other agents to treat infectious diseases, such as anti-infective sera. Ehrlich’s collaboration was essential to Behring’s development of the anti-diphtheria serum. It is an essential film for lovers of the popularization of chemotherapy, and it is important to remember the movie because 2004 celebrated 100 years since Ehrlich began his work in this field (4). This film did justice to the falseness of *Robert Koch* (1939), a film made under the Nazi regimen where the character of Paul Ehrlich was suppressed simply because he was of Jewish origin. In this last film, Koch comments that understanding the causative agent of tuberculosis was a necessary step in discovering a remedy to fight it, but it does not mention that he used tuberculin for this purpose.

ANTIBACTERIAL CHEMOTHERAPEUTICS

After its discovery, salvarsan was widely used and its use is reflected in several movies. In *Out of Africa* (1985) the novelist Karen Dinesen Blixen returns to her native Denmark to receive salvarsan to treat the syphilis she contracted from her husband. The treatment of syphilis with salvarsan was long, not always successful and caused many side effects.

Miss Evers’ Boys (1997) is a TV movie with healthcare issues of enormous interest. It mirrors the syphilis experiments that were performed with the black population in Tuskegee from 1932 to 1972. In the first part of the movie, patients were treated with salvarsan and mercury rubs in order to control the illness in a population where the incidence of the disease was high. In the second part, which takes place later for obvious racial reasons, the evolution of syphilis without treatment was being analyzed in order to see whether black people were equally affected as white people. The study of reference had been performed in the 19th century in Sweden, and at that time no treatment for syphilis was available. When this experiment reached the general public, it had a huge impact and contributed to the development of bioethics. From the point of view of antimicrobial chemotherapy, this film shows that



Figure 1. *Dr. Ehrlich’s Magic Bullet* (1940) is the greatest movie about chemotherapy.



Figure 2. *Exodus* (1960): "Excuse me. This boy has a skin infection called impetigo. He needs sulphathiazole on those scabs".

treatment with salvarsan was long and not always effective. Furthermore, since it covers a long period of time, it provides proof on how the discovery of penicillin significantly changed the situation.

Salvarsan was substituted by neosalvarsan, another less toxic arsenical compound. In *Captain Corelli's Mandolin* (2001), its use by the Italian troops in the Greek island of Cephallonia in WWII is mentioned.

In 1925, gold salts began to be used for the treatment of tuberculosis and their use spread across Europe after 1934 (5). Their use is seen in *The Nun's Story* (1959), where the protagonist contracts tuberculosis while on a mission in the Belgian Congo and the doctor prescribes her gold salts and also recommends that she drink copious amounts of Belgian beer to reduce the nephrotoxicity caused by the gold salts.

For many years bismuth salts were used to treat peptic ulcers. Discovery of the involvement of *Helicobacter pylori* in this disease and its *in vitro* susceptibility to the bismuth explains its usefulness (6). In *Not as a Stranger* (1955) there is a dialogue reflecting the use of bismuth salts in those times and the dosage criteria, "double dose of bismuth, it's a lovely ulcer".

The sulphonamides were introduced into clinical practice in the 1920s (7). These drugs were widely used during WWII and their use is also seen in many films. When watching them, one senses that tons of sulphonamides were distributed for prophylactic and therapeutic purposes until the arrival of penicillin. *Destination Tokyo* (1943) is one of these films where they are used as a prophylactic antimicrobial agent in an appendectomy; and in *Bataan* (1943) and *Saving Private Ryan* (1998) they are used against firearm wounds. Even some films such as *The Guns of Navarone* (1961) showed how useful they were while unavailable. Other war films where sulphonamides

were used include *The Story of Dr. Wassell* (1944), *Merrill's Marauders* (1962) and *None but the Brave* (1965). In some they were distributed without even mentioning the name as happens in *Kelly's Heroes* (1970).

Certain indications for the use of sulphonamides years ago are captured in films. For instance, they were used topically for the treatment of impetigo, as was seen in *Exodus* (1960), and as nonabsorbable derivatives in the treatment of gastroenteritis in *La Gran Familia* (1962).

ANTIBIOTICS

The life of Sir Alexander Fleming has never been depicted in a movie. WWII triggered the development of penicillin. There were countless wounded with infections, and to control them it was necessary to have an antimicrobial agent better than the sulphonamides. The industrial production of penicillin filled all these expectations. During the war, this antibiotic was used for the first time by the Allied soldiers in the north of Africa during 1943 (8). The Germans were able to manufacture it, but only in small amounts, and the sulphonamides remained the only antimicrobial available on a large scale. Hitler received penicillin, prescribed by his doctor, on more than one occasion (9). Some of these facts have been reflected in the cinema. The Allied soldiers were conscious of the importance of penicillin whereas the German soldiers had little knowledge of it, as can be seen in *Force 10 from Navarone* (1978). In *Two-Man Submarine* (1944), the Axis forces try to obtain the procedure used by an American scientist to produce penicillin from a mushroom on a Pacific Island. It should be pointed out that this film was actually made during WWII. The film *Mykoin PH 510* (1963) tells the story of how Czech scientists obtained penicillin during the Nazi occupation. In *Der Untergang* (2004), it is clear that by the end of the war penicillin was available to the Nazis and the antibiotic was taken to Hitler's bunker.

The impact of penicillin on the world was enormous and after WWII its use became widespread and it was even used in Soviet concentration camps [*So weit die FüÙe tragen* (2001)]. The major problem with penicillin was the lack of its availability, and that was the reason why so many mafias stole it, generally from military hospitals, smuggled and adulterated it. *The Third Man* (1949), a great film noir in which antibiotics are central to the plot, reflects this situation in postwar Vienna, where a gang of heartless criminals stole penicillin from British military installations, later adulterating and selling it. Adulteration reduces the quantity of the active principle, thus resulting in therapeutic failure, with dramatic effects when used on children with

meningitis. *Mercado Prohibido* (1952) shows how penicillin, streptomycin and chloramphenicol were smuggled into Francoist Spain. Other movies such as *Kiss the Blood Off My Hands* (1948) also covers these aspects. These events are now comparable to the current situation existing in Africa with antiretrovirals (10). In *Yakuza* (1975), the main character obtains smuggled penicillin for the daughter of his lover three years after the American occupation of Japan.

Miss Evers' Boys (1997) captures very interesting aspects of penicillin G sodium, such as its parenteral administration, its solubility in water and saline solution, and its painful intramuscular administration. Furthermore, it reflects a transcendental act in the correct use of antimicrobials, restricting their use to medical prescription, which actually is not always fulfilled in many countries. In *The Trigger Effect* (1996), where amoxicillin is needed to treat an ear infection in a little boy, the drug was not dispensed because his father did not have a prescription.

As mentioned earlier, *Miss Evers' Boys* (1997) demonstrates the efficacy of penicillin in the treatment of syphilis in 1942. It also mentions its efficacy in treating sepsis and pneumonia. In *White Squall* (1995) and in *Besos para Todos* (2000) the efficacy of penicillin is shown against gonorrhoea, which is of historical importance considering the current resistance of *Neisseria gonorrhoeae* to this antibiotic.

Penicillin is usually thought of as a sodium salt for parenteral administration. However, other salts, derivatives and presentations are also important as is the case with pro-



Figure 3. *The Third Man* (1949): diluted penicillin.



Figure 4. *Miss Sadie Thompson* (1953): "We need more penicillin and Bibles".

caine penicillin, mentioned in *Not as a Stranger* (1955), and oral penicillin as depicted in *Tarzan's Greatest Adventures* (1959) and *Kolya* (1996).

On several occasions, cinema has shown that having penicillin and other antibiotics available is an essential need. For example, in *Miss Sadie Thompson* (1953) when benefactors visit a Samoan hospital and the director asks them to send more penicillin, the drug is compared to the Bible ("We need more penicillin and Bibles").

There is no doubt that penicillin is still useful and this is clearly stated in *The Day After Tomorrow* (2004). In this doomsday movie, one of the characters suffers an injury that becomes infected and he develops sepsis; with information obtained from medical books, friends treat him with penicillin found in a Russian ship. The "miracles" of the cinema allow the patient to be cured with just one injection. Furthermore, in the medical books that his friends consulted, sepsis is to be treated with high doses of penicillin or with a broad-spectrum antibiotic, an important concept in antibacterial therapy, and must be administered immediately.

Infections that do not respond to penicillin and the need for alternate antibacterial agents was clearly stated many years ago in *White Corridors* (1951). In addition to penicillin, movies have mentioned other antibiotics by their chemical or commercial names. Although their importance has been considered, the impression is given that they are not cited concretely so as not to cause false expectations and unnecessary consumption. Occasionally, the use of other types of penicillin can be deduced from the dosage



Figure 5. *The Doctor* (1991): "I'll write you a note for some antibiotics".

and administration but not because of mentioning its name. In *Kolya* (1996), by Jan Sverák, there is a reference to oral penicillin. When faced with a respiratory infection in a boy, oral penicillin V is prescribed every 4 hours. A similar use is shown in *Castaway* (1987) for a traumatic leg infection, but in this case they relied more on an anti-staphylococcal penicillin. In *Dr. T and the Women* (2000) and in *The Trigger Effect* (1996), the use of amoxicillin is described.

Other antibiotics mentioned in films include streptomycin, used for the plague in *Panic in the Streets* (1950), for undetermined infections in *Mercado Prohibido* (1952) and for rheumatic fever in *Demonios en el Jardín*, chloramphenicol for typhoid fever in *Mercado Prohibido* (1952) and *Not as a Stranger* (1955) and tetracyclines for cholera in *Contagious* (1997).

The prophylactic use of antibiotics has also been shown in various films. Penicillin was used for the prevention of skin and soft tissue infections in *The Year of Living Dangerously* (1982). Streptomycin, together with an anti-plague serum, were used to prevent pneumonic plague in *Panic in the Streets* (1950). Penicillin was used to prevent the appearance of anthrax in *Anthrax* (2001). In *John Q* (2002), prophylactic antibiotics were administered to a boy who was awaiting a cardiac transplant and in *Minority Report* (2002) they were administered before the character received new eyeballs.

Popular belief has led to the idea that certain fungi might cure or prevent infections. In *The Horse Soldiers* (1959), a skin and soft tissue infection is treated with a Cheyenne remedy, a poultice of green mold (penicillin?). In *Two Mules for Sister Sara* (1969), an infection from an

arrow wound is prevented using moss after it has been cauterized by gunpowder.

OTHER FACTORS OF ANTIBACTERIAL CHEMOTHERAPY

As with many other drugs, one of the problems related to the use of antibacterial agents is the occurrence of adverse side effects. Fictional cinematographic exaggerations in *The Fugitive* (1993) revealed how a pharmaceutical laboratory and a well-known doctor collaborated to commercialize a potentially deadly drug. And the cinematographic adaptation of the novel by John le Carré of the same title, *The Constant Gardener* (2005), describes a similar situation, in this case the testing of a new antituberculosis drug active against multiresistant *Mycobacterium tuberculosis* in African people.

Allergic reactions, mainly anaphylactic shock, are a side effect of penicillin that appears most frequently in films [*The Carey Treatment* (1972) and *Disturbed* (1990)]. In some movies, an earlier history of allergy was used to induce anaphylactic shock for criminal purposes [*The Net* (1995)]. In movies, patients are normally requested to inform their physicians about previous allergic reactions before administering an antibiotic [*Anthrax* (2001) and *The Cassandra Crossing* (1977)]. In *Miss Evers' Boys* (1997), it was mentioned that patients with advanced syphilis may experience a Herxheimer reaction due to penicillin, although it was made clear that this side effect is infrequent.

The abuse of antimicrobial agents is seen in *The Doctor* (1991). The character has larynx cancer. Prior to his diagnosis he coughs and presents hoarseness and hemoptysis, but fever is absent. When he goes to the doctor, he is prescribed antibiotics in case there is an infection. Respiratory infections are often used to reflect the abusive consumption of antibiotics. In *The Taking of Pelham One Two Three* (1974) the mayor of New York has the flu and he is administered antibiotics parenterally. A fundamental tenet in antimicrobial chemotherapy is that viral infections cannot be treated with antibiotics. Images such as those seen in this movie could have a negative effect on viewers.

Another cause of the misuse of antibiotics is incorrect selection. In *Demons in the Garden* (1982), where the plot takes place in post-civil war Spain, a boy with rheumatic fever is treated with streptomycin, which in those days was hard to come by. Penicillin is used to prevent rheumatic fever and the mention of streptomycin in the film could be due to a documentation error by the scriptwriter or to poor medical practices at that time.

Also, the general population notices physicians's mistakes, as does Carol Connelly, a character in *As Good as It Gets* (1997), when she says the hospital has wrongly chosen her son's antibiotic.

Even with an appropriate choice of antibiotics, therapeutic failure is a fact in antimicrobial chemotherapy due to the host, to the antimicrobial or to the infectious agent. *Dr. T and the Women* (2000) demonstrates this: "the amoxicillin has not been efficacious". An important cause of therapeutic failure is multiresistance. In *Contagious* (1997), the main character appears in the plot when isolating a patient suffering from tuberculosis produced by multiresistant *Mycobacterium tuberculosis*. In this movie, the idea of using isolation in some cases of multiresistant bacterial infections is raised. *White Oleander* (2002) shows how the impact of antimicrobial resistance was known to the population when in a scene where a woman welcomes the young co-character into her house she tells her that some gonococci may be multiresistant.

Price is a limiting factor in the use of many drugs, including antiinfective agents, and as such is mentioned in *Patch Adams* (1998) where a patient asks: "Did you know the antibiotics cost me \$100 a month?"

CONCLUSIONS

Antimicrobial agents and other antiinfective procedures are depicted in many films, usually only as an element within the script, as occurs in real life for most people. Movies have used antimicrobial agents quite well and even though there have been some exaggerations and fiction in some of the films, they have been presented, explicitly or implicitly, as very efficient drugs without any exaggeration. Only a few films inadequately portray these drugs. It is recognized that antimicrobial agents are giants among the therapeutic arsenal, insofar as they have actual-

ly been administered to "giants", such as the tyrannosaurus baby of *The Lost World: Jurassic Park* (1997) which received ampicillin prophylaxis as part of his leg fracture reduction.

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