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Review

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Preoperative Antibiotic Prophylaxis in Ophthalmology

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Abstract

The most common microorganisms involved in postoperative endophthalmitis are Coagulase-negative staphylococci(CNS), *Staphylococcus epidermidis*, *Staphylococcus aureus*; and most of the bacteria are found in the eyelids, tear film and adnexa. The substance that has proven bactericidal activity and contributes to prophylaxis in preoperative use is povidone iodine. Many studies were conducted for assesing the effect of preoperative prophylactic antibiotic use additional to povidone iodine. No clear benefit was found in applying preoperative antibiotic drops but antisepsis with povidone iodine or chlorhexidine is mandatory to reduce the ocular surface colony count, before intraocular surgeries.

Keywords: Prophylaxis, preoperative, antibiotic, surgery, ophthalmology, eye

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Introduction

For many years, from the Babylonians to the Egyptians and from ancient Greek medicine to Islamic medicine and Avicenna, unsuccessful surgeries were emphasized, progress was tried to be made through observations, and the reason for the infections developing after the operations pushed many scientists of the period to think about this (Figure 1 and 2). The idea that infections spread through invisible droplets was first brought to the agenda by Akşemsettin, the teacher of the Ottoman Emperor Mehmet the Conqueror (1-6). Akşemsettin was the first scientist to express the idea that infections may be caused by creatures invisible to the naked eye. Regarding this, he said: "It is wrong to think that diseases appear in humans one by one. Diseases are transmitted from person to person. This transmission occurs through living seeds that are too small to be seen with the naked eye."(6).

Later, in 1670, Anton van Leeuwenhoek identified microbes by examining them under a microscope. In the mid-19th century, Louis Pasteur discovered that microorganisms caused food to spoil, and later in the same century, Robert Koch discovered that tuberculosis, cholera, diphtheria and anthrax were caused by microorganisms. It was determined that surgical success was better by eliminating microorganisms in the surgical area. It was Joseph Lister who pioneered this. Lister using Phenol for antisepsis; he sterilized the operating room and surgical instruments with phenol, and even dipped the bandages in this substance before dressing the wounds (7).

With the development of technology and techniques, prophylaxis practices came into play. Phylaxis literally means to protect, and pro-phylaxis means to protect before. In fact, if we look at it in this sense, all procedures performed before surgery can be examined under the

Figure 1. Cataract surgery in ancient times

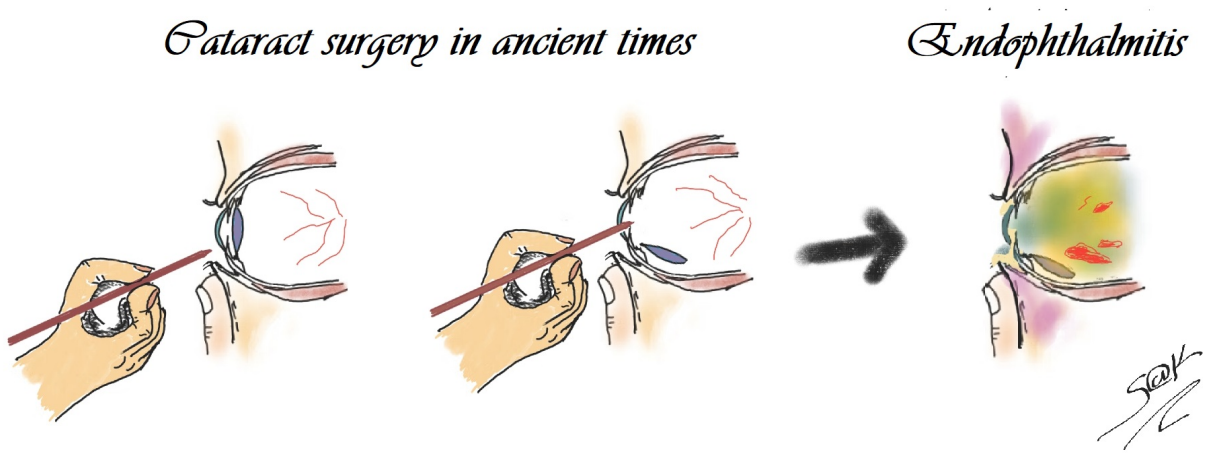

Figure 2. Most of the cataract surgeries in ancient times resulted with endophthalmitis.

concept of prophylaxis. In this review, we will focus on antibiotic prophylaxis before eye surgery.

Antibiotic Prophylaxis

One of the first prophylaxis applications in the field of eye diseases was made by Dr. Crede in 1880. Dr Crede, an obstetrician and gynecologist, has used 2% silver nitrate in newborns against Neisseria gonorrhoea neonatal conjunctivitis.(8)

In surgeries, wounds are divided into 4 groups:

Clean: Surgical wounds (Figure 3)

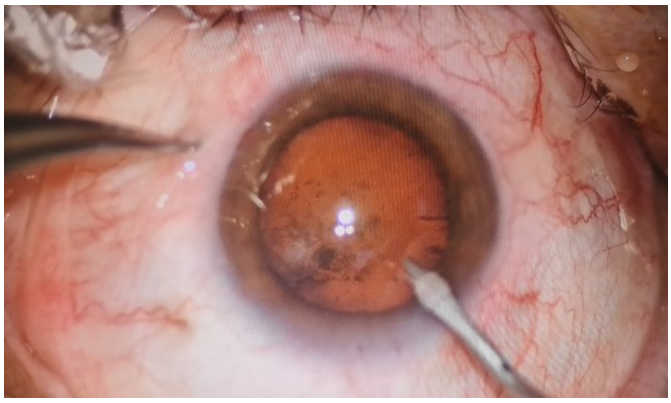

Figure 3. Cataract surgery wounds are clean wounds.

Clean-contaminated: Gastrointestinal system, urinary system, respiratory system surgical wounds (Figure 4)

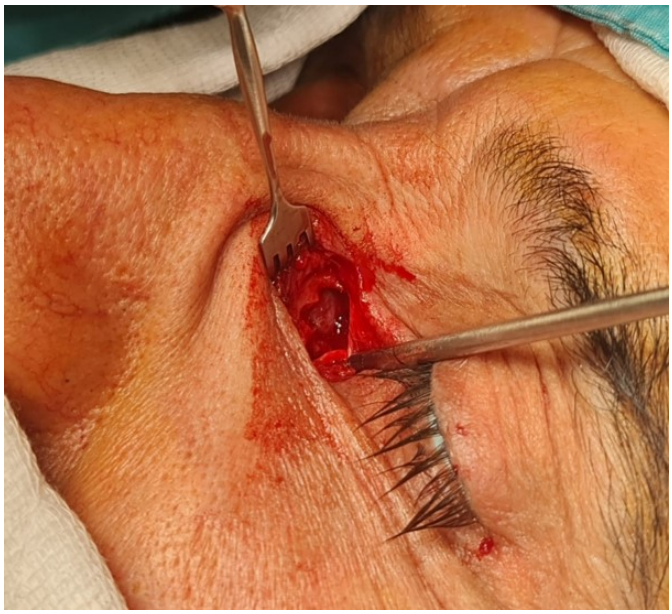

Figure 4. Dacryocystorhinostomy surgery wounds are clean-contaminated wounds because of relations with respiratory system.

Contaminated: Fresh trauma wounds (Figure 5)

Figure 5. Periorbital fresh trauma wound.

Dirty: Old trauma wounds, presence of dead tissue, foreign body in the wound area (Figure 6)

Figure 6. Periorbital dirty old trauma wound with infected and necrotic tissue.

Guidelines recommend antibiotic prophylaxis for clean and contaminated wounds. In case of implant placement, prophylaxis is also recommended for clean wounds. However, most of these approaches are in the form of antibiotic prophylaxis, which starts perioperatively and continues in the postoperative period (9-10).

As a general approach, it has been emphasized that antibiotic prophylaxis is of no benefit after wound closure, that there is no significant difference between single dose and multidose administration, and that long-term use of prophylactic antimicrobials may cause the emergence of resistant bacterial strains and make the patient susceptible to infection (11-13). In prophylaxis antibiotic application, giving the appropriate antibiotic, giving adequate dosage, ensuring proper timing

before incision, and maintaining drug levels throughout the operation, are important principles (14).

Preopertive Prophylaxis in Ophthalmology

Intraocular surgeries

It has been determined that the source of infection in eye diseases is bacteria found in the eyelids, tear film and adnexa. The most common microorganisms involved in postoperative endophthalmitis are Coagulase-negative staphylococci(CNS), Staphylococcus epidermidis, Staphylococcus aureus (15,16). According to a study using molecular epidemiological techniques in endophthalmitis cases, it was found that in more than 80% of cases, microorganisms isolated from the vitreous were genetically indistinguishable from conjunctival organisms isolated from the patient's eyelid (15).

Studies have found that there was a decrease in acute postoperative endophthalmitis after cataract surgery with phacoemulsification from 0.145% to 0.053% from 2005 to 2014. This has been found to be associated with an increase in the use of intracameral antibiotics during surgical procedures during the same period (17). A study was conducted considering that the lid margin could be a source of infection. In this study, both eyes were washed with saline solution before cataract surgery. For the first eye, the fornix and ocular surface were washed with saline solution, and for the second eye, the fornix, ocular surface and lid margin were cleaned with saline solution. According to the results of this study, it was determined that cleaning the eyelid margin with normal saline solution immediately before intraocular surgery did not help reduce the microbial load on the ocular surfaces. It was determined that the rate of bacterial contamination did not increase because the meibomian glands were not compressed during the procedure (18).

The substance that has proven bactericidal activity and contributes to prophylaxis in preoperative use is povidone iodine. Povidone iodine, discovered in 1955; for the first time in 1984, Apt et al. has been shown to reduce approximately 90% of ocular surface flora (19). It has subsequently been the subject of many studies (15,16).

"ESCRS Guidelines for Prevention and Treatment of Endophthalmitis Following Cataract Surgery" published by ESCRS in 2013 stated that disinfection of the cornea, conjunctiva and periorbital area with povidone

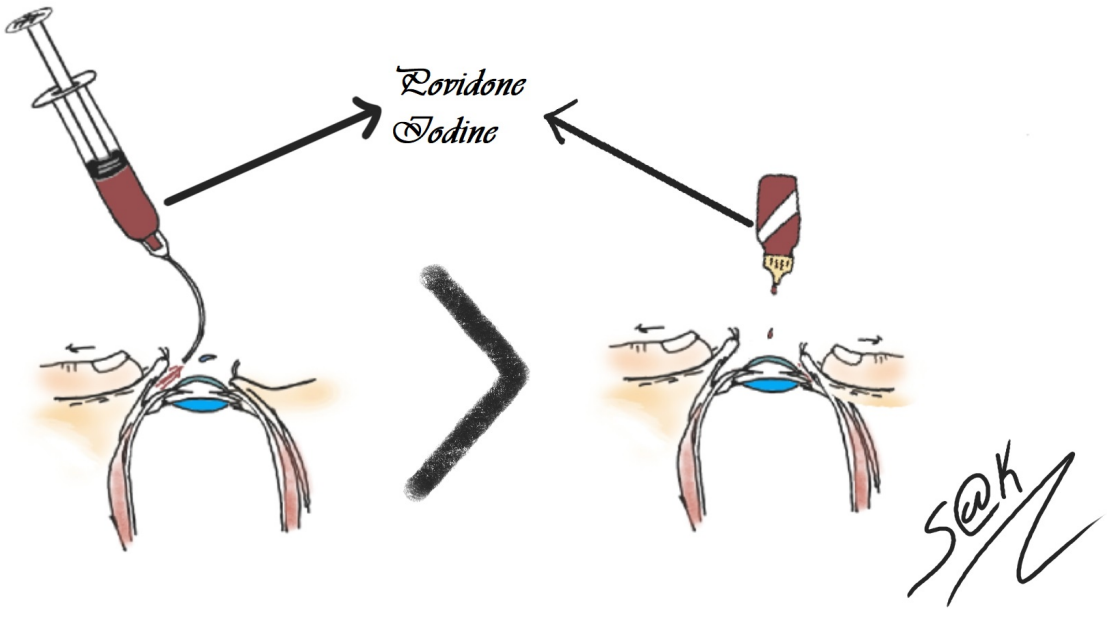

Figure 7. Washing the conjunctival fornices with povidone-iodine reduces the growth in cultures taken both preoperatively and postoperatively more than applying povidone-iodine drops to the eye.

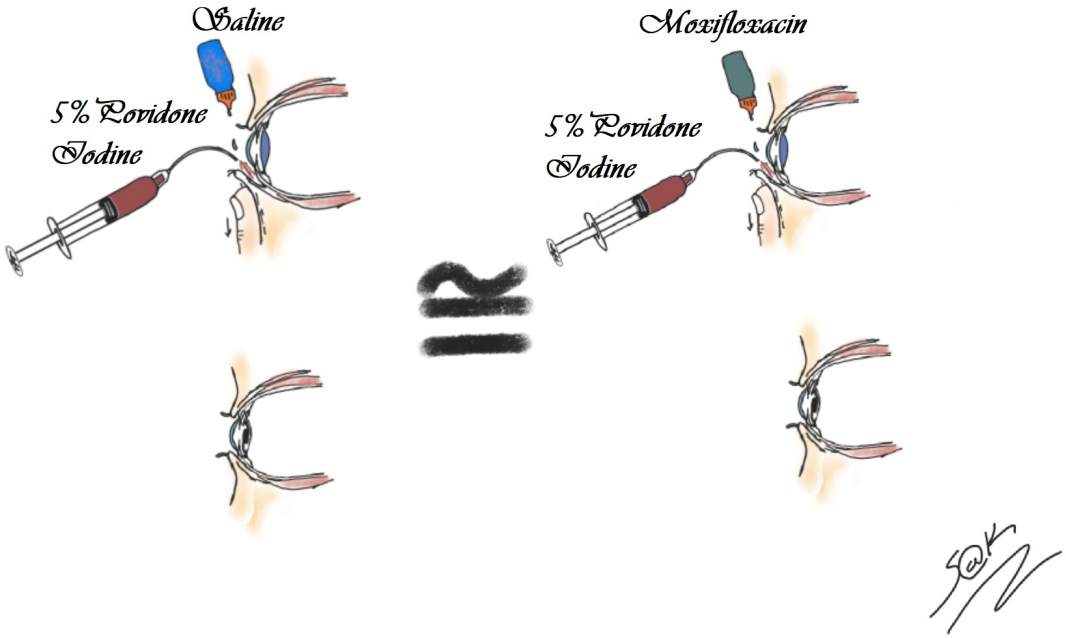

Figure 8. Adding topical 0.5% moxifloxacin to 5.0% povidone-iodine had no significant effect.

iodine is mandatory (20).

In the study conducted by Mino de Kaspar et al., in addition to instilling Ofloxacin eye drops into the eye before surgery, instilling 2 drops of povidone iodine into the eye and washing the conjunctival fornices with 5% povidone iodine were compared. Preoperative and postoperative cultures were taken and microorganism growth in the culture was compared. It has been determined that washing the conjunctival fornices with povidone-iodine reduces the growth in cultures taken both preoperatively and postoperatively more than applying drops to the eye surface (21) (Figure 7). Halachmi-Eyal et al. examined the effect of moxifloxacin used in addition to the preoperative use of 5% Povidone-iodine. While they applied saline solution and 5% povidone iodine drops to one of the two groups in their study, they applied moxifloxacin and 5% povidone iodine drops to the other group. While the growth rate in the culture before the drop was 38% in the group in which saline drops were instilled, this rate decreased to 4% after saline and povidone-iodine. In the group receiving moxifiloxacin drops, the rates were found to be 41% and 3%, respectively. It was determined that adding topical 0.5% moxifloxacin to 5.0%

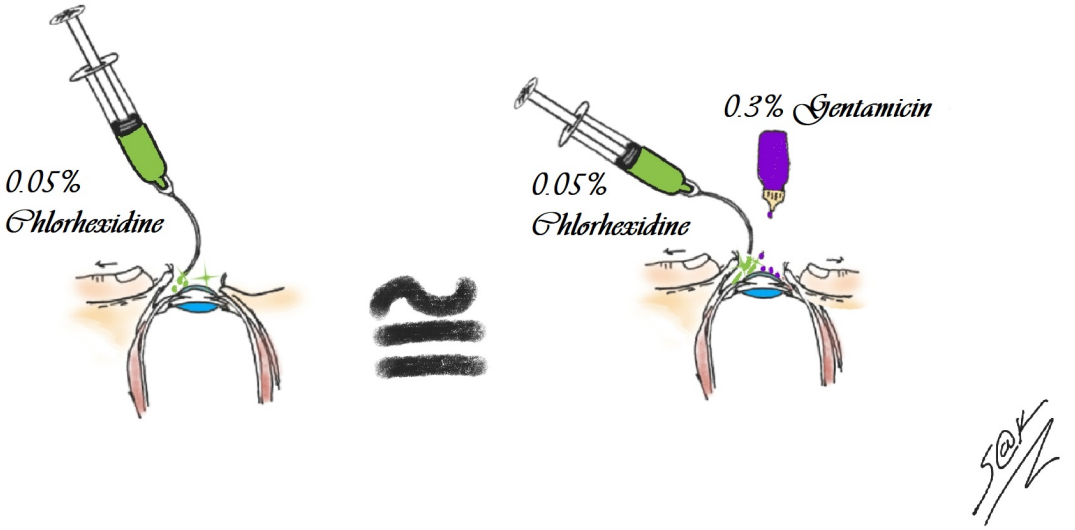

Figure 9. The conjunctival flora was significantly suppressed by chlorhexidine rinsing alone. No other significant antibacterial effects were observed with gentamicin prophylaxis.

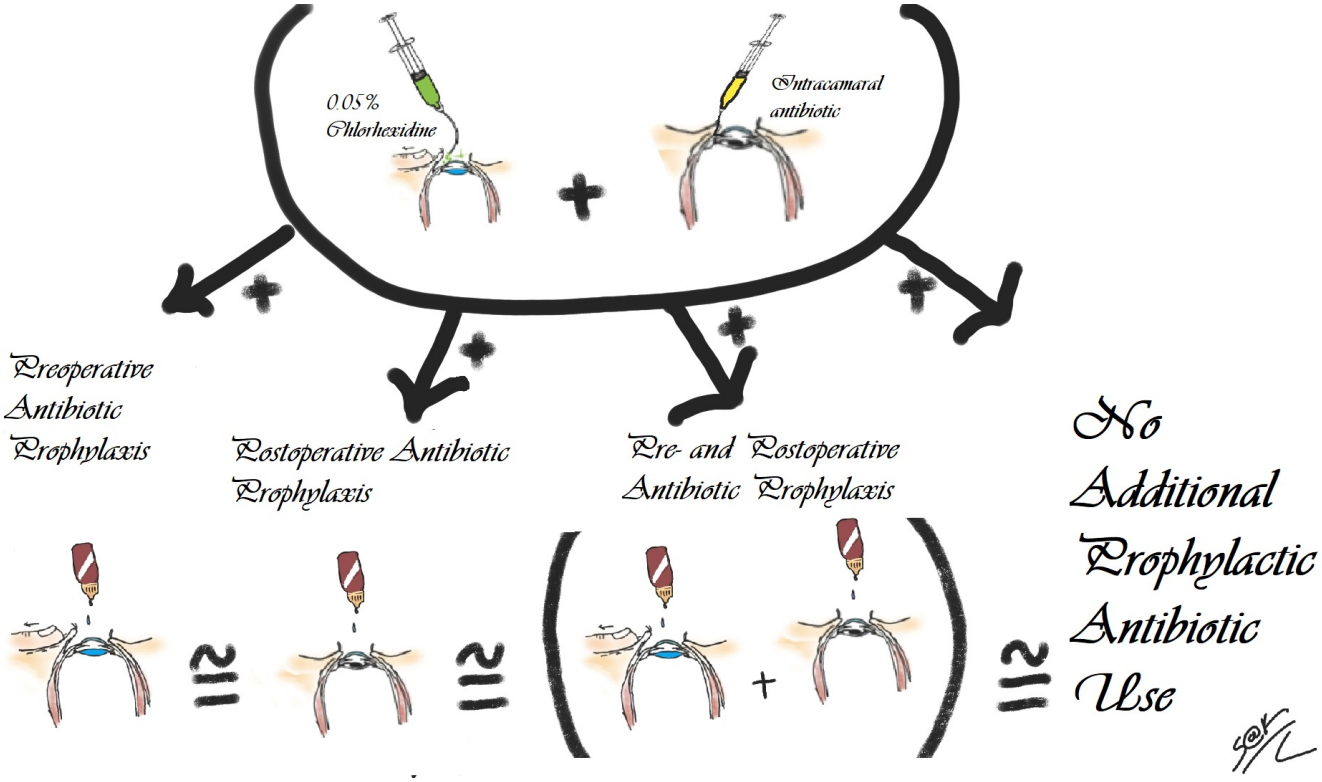

Figure 10. Endophthalmitis rates were similar with preoperative antibiotics prophylaxis, postoperative antibiotic prophylaxis, pre- and postoperative prophylactic antibiotic use, and not using additional prophylactic antibiotics.

povidone-iodine had no significant effect (22) (Figure 8) .

There are studies showing that Chlorhexidine (CHX) can be used when povidone-iodine cannot be used. In a study conducted in Sweden, conjunctival cultures taken from eyes undergoing vitrectomy surgery were compared. After 1 drop of chloramphenicol was instilled before the surgery, a conjunctival culture was taken, then the surgical area was cleaned with chlorhexidine, and a culture was taken again at the end of the surgery. In addition to conjunctival cultures, vitreous samples were also taken at the beginning and end of surgery. In this study, which included 40 eyes of 39 patients, an 82% decrease in the amount of colony forming units was detected with 0.05% Chlorhexidine. A 90% decrease in the rate of Coagulase-negative staphylococci alone was detected. The number of eyes with positive bacterial growth in conjunctival samples was found to decrease from 33 to 18 after irrigation with CHX (P = 0.0023). No cases of endophthalmitis after vitrectomy were reported by the authors during the follow-up period. As a result, this study emphasized that CHX, used as the sole disinfectant agent, could be an effective preoperative procedure in eye surgery (23). In another study by Montan et al., conjunctival rinse with 0.05% chlorhexidine solution and 0.3% gentamicin ophthalmic eye drops given four times in 45 minutes was compared with 10 ml of 0.05% chlorhexidine solution. 76 patients undergoing phacoemulsification surgery were included in the study. Cultures were obtained preoperatively, 5 minutes after gentamicin and chlorhexidine prophylaxis or chlorhexidine prophylaxis. It was determined that the conjunctival microflora was significantly suppressed by chlorhexidine rinsing alone ($p = 0.001$). No other significant antibacterial effects were observed with experimental gentamicin prophylaxis (24) (Figure 9). Friling et al. compared the use of antibiotic drops for preoperative prophylaxis, postoperative prophylactic antibiotic use, pre- and postoperative prophylactic antibiotic use, and not using additional prophylactic antibiotics, in addition to disinfection with Chlorhexidine before intraocular surgery and intracameral antibiotic use at the end of surgery. Endophthalmitis rates were determined as 0.017%, 0.019%, 0.041% and 0.025%, respectively, and they were not

found to be statistically significant from each other (25) (Figure 10).

He et al. found no further reduction in conjunctival flora when fourth-generation fluoroquinolone drops were applied 4 times a day for 1 day instead of 3 days (26). Moss et al also found no difference in the reduction of conjunctival flora following povidone-iodine when the fourth-generation fluoroquinolone was added 4 times daily for 3 days. Conjunctival cultures were positive in 4% of eyes treated with povidone iodine, while they were positive in 8% of eyes treated with gatifloxacin and povidone iodine (27).

The above studies have revealed that the use of prophylactic antibiotics in addition to preoperative surgical disinfection with povidone iodine or chlorhexidine before intraocular surgeries does not provide additional benefit. However, there are also studies showing that preoperative prophylactic antibiotic use causes more harm than benefit. In one of the studies examining endophthalmitis rates after intravitreal injection, it was found that the rate of endophthalmitis increased 1.7 times in prophylactic antibiotic use, and in another study, it increased 3 times. It is thought that these findings may be due to the decrease in beneficial microorganisms with the use of antibiotics (28-30).

Oculoplastic surgeries

In a study published in 2020 that included a total of 1208 patients who underwent orbital surgery, the patients were divided into 2 groups. 603 did not receive antibiotic prophylaxis. 605 of them received a single dose of intravenous antibiotics. A single dose of i.v antibiotics was given 60 minutes before the surgical procedure. Wound infection occurred in a total of five patients (0.42%), 3 in the group that did not receive prophylaxis and 2 in the group that did. ($p = 0.66$). In this study, antibiotic prophylaxis, alloplastic implants, paranasal sinus entrance, and corticosteroid use were not associated with differences in wound infection rates. Antibiotic prophylaxis did not appear to reduce the already low incidence of wound infection following orbital surgery. In conclusion, this study emphasized that routine perioperative antibiotic treatment should not be needed, but that it is important for patients undergoing orbital surgery to be educated about the early symptoms of postoperative infection (31).

In another study, 608 orbital surgeries without prophylaxis were evaluated. 226 of these surgeries were clean orbital surgeries, and 290 were clean orbital surgeries with implants. 92 were classified as clean contaminated surgery. Wound infection was detected in only five of 608 patients (0.82%), and their numbers are 1, 3 and 1, respectively, according to the groups. In this study, the authors recommended restricting the use of systemic antibiotic prophylaxis in orbital surgeries. They found that in cases where postoperative infection occurred, patients could be effectively treated with systemic antibiotics (32).

Cost-benefit analysis

In a very recent study conducted in the United States in 2023, the life-long costs and effects of preoperative topical antibiotic prophylaxis and no prophylaxis were predicted for a simulated cohort of 500,000 adult patients requiring cataract surgery. The incidence of endophthalmitis after cataract surgery for preoperative topical antibiotic prophylaxis compared to no prophylaxis. When compared, it was found to be 0.03% and 0.042%, respectively. This was calculated as an absolute risk reduction of 0.008%. The average lifetime cost of cataract surgery with and without antibiotic prophylaxis was calculated as US$ 2,486.67 and US$ 2,409.03, respectively. Based on their findings, the authors determined that prophylaxis would be cost-effective if the incidence of endophthalmitis after cataract surgery was greater than 5.5% or if the price of preoperative topical antibiotic prophylaxis was less. The general use of preoperative

topical antibiotic prophylaxis has not been found to be cost-effective compared with no prophylaxis in preventing endophthalmitis after cataract surgery. However, preoperative topical antibiotic prophylaxis has been shown to be cost-effective in hospitals with a high incidence of endophthalmitis and/or in situations where the cost of prophylaxis is significantly lower (33).

In conclusion, no clear benefit was found in applying preoperative antibiotic drops. Although it can induce bacterial resistance, it does not provide complete bacterial eradication on the ocular surface. However, antisepsis with povidone iodine or chlorhexidine is mandatory to reduce the ocular surface colony count as much as possible before cataract surgery (20) (Figure 11).

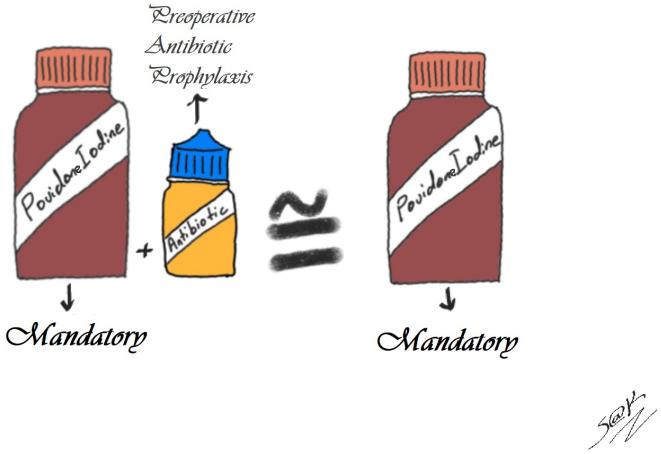

Figure 11. No clear benefit was found in applying preoperative antibiotic drops.

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