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PRACTICAL DERMATOLOGY

Antibiotic Prophylaxis in Dermatologic Surgery

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Abstract. This article discusses factors to take into consideration for the rational use of antibiotics to prevent postoperative infection in dermatologic surgery. The treatment of choice is described.

Key words: dermatologic surgery, antibiotics.

PROFILAXIS ANTIBIÓTICA EN CIRUGÍA DERMATOLÓGICA

Resumen. Se analizan los factores a considerar en el uso racional de los antibióticos en la cirugía dermatológica con el objeto de evitar la infección postoperatoria. Se describe el tratamiento de elección.

Palabras clave: cirugía dermatológica, antibióticos.

The use of surgical techniques by the dermatologist is a relatively recent phenomenon. As in any type of surgery, one of the possible complications is surgical wound infection. Although the incidence of infection is low (2%-3%), even in Mohs surgery, the insistence on prevention sometimes leads to indiscriminate use of antibiotics, which in turn produces adverse effects, facilitates the development of bacterial resistance, and increases health spending.[1-4] Hence the interest in drawing up more accurate indications for the use of antibiotics in dermatologic surgery.

Cutaneous surgery covers minor interventions carried out in the doctor's office and includes cryotherapy, electrosurgery, biopsies, and minor excisions of both benign and malignant tumors, as well as laser therapy. These interventions are quick and are generally performed on patients with a low risk of infection; therefore, antibiotics are only prescribed in exceptional cases.

Scheduled interventions that are considered more important either because of the type, size, or location of the lesion, or because of the patient's general status are carried out in the operating room. They are carried out under local or general anesthetic and involve techniques such as excision and direct closure, vermilionectomy, wedge resection, local flaps, total or laminar skin grafts using a manual or electric dermatome, Mohs surgery, and laser treatment. These interventions are usually more complicated and take longer to complete.

There are no protocols with absolute guidelines for the appropriate use of antibiotics in dermatologic surgery, although it is worth taking into consideration the 1997 recommendations of the American Heart Association (AHA) and those of the Centers for Disease Control and Prevention from 1999. These are the internationally recognized authorities in this field.[5]

Below, we analyze the most essential aspects of a better use of antibiotics in dermatologic surgery. These include the objectives of antibiotic prophylaxis, factors that can affect surgical infection, etiologic agents, choice of antibiotic, duration of prophylaxis, indications for prophylaxis of postsurgical infection, and, lastly, prophylaxis of bacterial endocarditis and infection of joint prosthesis and other implants.

Objectives of Antibiotic Prophylaxis

1. To prevent postsurgical infection at the surgical site. Although this type of infection does not usually place the patient's life in danger, it is a serious complication in cutaneous surgery because it causes pain, delays cure, and considerably delays wound healing.[6,7]
2. To prevent distant infection. It is very important to prevent endocarditis in high-risk patients (those with prosthetic heart valves) by following the criteria established by cardiology associations.[5] The use of antibiotic prophylaxis in patients with other types of device or implants (joints, pacemakers, arterial grafts, peritoneal shunts, genitourinary devices, and breast implants) is questionable.[1,5,6]

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Factors That Affect Surgical Infection

These are divided into 3 groups: environmental factors, factors which depend on the patient's general status, and factors related to the surgical field.

The environmental factors that favor infection include preoperative hospitalization, shaving 24 hours before surgery, duration of surgery (the risk of infection doubles with every hour of surgery), drainage, inappropriate surgical technique, inadequate hand hygiene by the surgeon, as well as not using gloves, masks, or caps, and deficient preparation of the surgical field. Washing with antiseptic soap has been shown to reduce the risk of infection—chlorhexidine gluconate and povidone iodine are the most widely used due to their greater antiseptic activity and antimicrobial spectrum, although washing with chlorhexidine is more effective.[5,6,8]

Other factors favoring infection depend on the patient's general status, because they reduce the capacity for an immune response. These include malnutrition, anergy, older age, obesity, distant infection (respiratory, urinary, cutaneous), diabetes mellitus, chronic renal insufficiency, peripheral vascular disease, leukemia, infection by the human immunodeficiency virus, immunosuppressive therapy (systemic corticosteroids, cyclosporine, or other agents), and smoking or drinking.

It is also important to take into account the types of surgical field, which are classified as follows[6]:

1. Class 1: Clean fields. Surgery is performed on uncontaminated skin using sterile techniques. This type of surgery includes excision of cysts and noninflamed benign and malignant tumors. The risk of infection is less than 5%.
2. Class II: Contaminated clean fields—the oral cavity; the nasal, aural, or respiratory tract; the axillas; the perineum; and the soles of the feet and the nails—superinfection affects 10% of cases.
3. Class III: Contaminated fields. These are nonpurulent lesions with acute inflammation (eg, intact cysts, inflamed tumors). Infection rates in these cases are between 20% and 30%.
4. Class IV: Infected surgical fields (ruptured cysts, hidrosadenitis, tumors containing purulent necrotic material, or devitalized tissue and foreign bodies). Infection occurs in 30% to 40% of cases.

This classification does not include healing by second intention.[3]

Pathogens Responsible for Infection

Knowledge of cutaneous flora will enable us to select the most appropriate drug for antibiotic prophylaxis. *Staphylococcus epidermidis* colonizes the upper part of the body and is considered the most common pathogen in endocarditis, but not in cutaneous infection.

Staphylococcus aureus is not part of the habitual flora, although it is present in the perineal area in 20% of the population and in the nares of 20% to 40% of the population. It is common after surgery and is often responsible for endocarditis.

The most common pathogens on hairless skin are *S aureus* and *Streptococcus pyogenes*. *Streptococcus viridans* and *S aureus* and *S pyogenes* are abundant on the mucosa. Enterococcus and *Escherichia coli* are isolated from the gastrointestinal and genitourinary tracts. Other germs are found in the intertriginous areas (*Corynebacterium*), on the toes (*Brevibacterium*), on the scalp, and on the back (*Propionibacterium* species and *Pityrosporum* species).[9]

Recently, there has been an increase in the incidence of surgical infection caused by drug-resistant germs and *Candida* species. This has been attributed to the excessive use of antibiotics and the increase in the number of immunocompromised patients who undergo surgery.[5,6]

Selection of an Antibiotic for Prophylaxis of Surgical Infection

Oral Antibiotics

Bearing in mind that prophylaxis must cover mainly staphylococci and streptococci, the antibiotic of choice is cephalexin, which is a first-generation cephalosporin (2 g before surgery and 500 mg 6 hours after if indicated) (Table 1).

Second choice antibiotics include amoxicillin (2 g) and dicloxacillin (2 g). The latter is not marketed in Spain. Although not exactly the same substance, cloxacillin is considered equivalent.

For patients who are allergic to penicillin and its derivatives, erythromycin was the drug of choice (1 g po before surgery and 500 mg after), although it is now being replaced by azithromycin (500 mg) or clarithromycin (500 mg), both of which cause fewer gastrointestinal side effects. Another good alternative in penicillin-allergic patients is clindamycin (600 mg).

Coverage with amoxicillin is inadequate for *S aureus*, although it is optimal for *S viridans*, thus making it the antibiotic of choice when it is required to act on the oral mucosa. For penicillin-allergic patients, we can use clindamycin, cephalexin (patients who have not had a class I reaction), azithromycin, or clarithromycin.[2,3,5]

Intravenous Antibiotics

The intravenous route is particularly indicated for antibiotic prophylaxis in patients with a peripheral line, in those

Table 1. Prophylaxis of Intraoperative Infection of the Surgical Wound

	First Choice	*Alternatives*	*Penicillin-Allergic Patients*
Skin	Oral	Oral	Oral
	Cephalexin, 2 g before surgery and 500 mg at 6 hours after	Amoxicillin, 2 g before surgery	Azithromycin, 500 mg before surgery
	Intravenous	Cloxacillin, 2 g before surgery	Clarithromycin, 500 mg before surgery
	Cephazolin, 1 g before surgery		Erythromycin, 1 g before surgery and 500 mg at 6 hours after
			Clindamycin, 600 mg before surgery
Oral mucosa	Oral		Oral
	Amoxicillin, 2 g before surgery		Azithromycin, 500 mg before surgery
			Clarithromycin, 500 mg before surgery
			Erythromycin, 1 g before surgery and 500 mg at 6 hours after
			Clindamycin, 600 mg before surgery

receiving parenteral nutrition because they are to be operated on under general anesthesia or sedation, and in those who cannot tolerate oral administration. In this case, cephazolin at 1 g can be administered during induction of anesthesia.[3,6]

Topical Antibiotics

An alternative approach to a systemic antibiotic is to administer prophylaxis locally to the surgical field. Topical administration does not rule out side effects, but it does reduce them.[8]

This approach can only be used in class III or IV contaminated or infected surgical fields. Cephazolin has been used, but its dose must be lower than the oral dose in order to avoid systemic absorption.[10]

Other authors use a mix of nafcillin (not marketed in Spain) with lidocaine at 1% and adrenaline at 1:100 000, by administering the local anesthetic and the antibiotic simultaneously. Nafcillin has been replaced by clindamycin.[5]

Prophylaxis with topical bacitracin or mupirocin after surgery does not appear to be totally justified, according to data from comparative studies showing that Vaseline is equally effective.[6] The same is true of topical gentamicin compared with Vaseline in the periauricular area.[11] Furthermore, there have been reports of contact dermatitis caused by bacitracin and resistance to mupirocin.[3,8]

Nevertheless, other authors who compare oral cephalexin with topical mupirocin in superinfected eczema found that mupirocin was more effective against bacterial infection.[12] Therefore, its application to sutures to prevent infection after surgery could also be more useful than oral cephalexin, although further studies are necessary.

The spectrum of topical fusidic acid is similar to that of mupirocin, with the added disadvantage that it can also be administered orally and its topical application favors resistance.[8]

Retapamulin is a recently marketed antibiotic with broad activity against gram-positive and some gram-negative bacteria. It is indicated for impetigo, secondary infections of wounds, and other dermatoses such as eczema, atopic dermatitis, contact dermatitis, and psoriasis.[8] With time, it could be considered for postsurgical infection, since the potential for resistance is less than or comparable to that of mupirocin and fusidic acid.

Argentic sulfadiazine is rarely used in dermatologic surgery, although it is an excellent antimicrobial agent that is effective against gram-positive and gram-negative agents and yeasts.[3,8] It is not available as an ointment, whose texture is more appropriate than that of cream for wet cures.

Duration of Antibiotic Prophylaxis

For antibiotic prophylaxis to be effective, the antimicrobial agent must be administered before the entry of microorganisms. It must reach high tissue and bloodstream concentrations at the time of surgery and remain at an appropriate concentration for a short time after surgery. Therefore, the antibiotic should be administered 30 to 60 minutes before surgery. If surgery is long, a second dose can be administered after 6 hours.

More prolonged administration of the antibiotic has been shown to replace the habitual microbial flora with resistant flora, intensify side effects, and increase spending on health care.

The effectiveness of administering the antibiotic only after surgery is doubtful and more therapeutic than prophylactic.[3,5,6,10,13]

Indications for Antibiotic Prophylaxis to Prevent Postoperative Infection

The dermatologist must consider the factors mentioned above when choosing whether or not to administer antibiotic prophylaxis. However, it is recommended when surgery is performed in the following cases:

1. Contaminated clean fields (class II): the oral cavity; the nasal, aural, or respiratory tract; the axillas; the perineum; and the soles of the feet and the nails. While some authors may question the use of prophylaxis in this setting, it is advisable.
2. Contaminated fields (class III): nonpurulent acutely inflamed lesions (eg, intact cysts, inflamed tumors).
3. Infected surgical fields (class IV): ruptured cysts, hidrosadenitis, tumors containing purulent necrotic material, or devitalized tissue and foreign bodies.

Prophylaxis is not necessary when surgery is performed on uncontaminated clean skin (class I surgical fields) or when noninvasive procedures such as nonablative laser or sclerotherapy are applied.[5]

Although techniques such as cryotherapy, shave excision combined with electrosurgery, punch biopsy, small surgical excisions, and ablative laser therapy are potential sources of bacteremia, antibiotic prophylaxis is not justified in any of them.[5,14]

In Mohs surgery, which requires long interventions, prophylaxis depends on the area involved. It could be justified in nose or ear flaps or grafts.[5] It does not seem to be useful in closure by second intention.[5,15]

Table 2. Prophylaxis of Postoperative Surgical Wound Infection

Indications	Nasal grafts or flaps
	High-tension closure
	Procedures involving inflamed or infected skin, or skin with cysts, or very sebaceous nasal tissue
	Multiple simultaneous procedures
	Surgery below the knee
	Surgery of the hand
Drugs	General
	Cephalexin, 500 mg to 1 g/12 h po
	Cloxacillin, 500 mg/6 h po
	Penicillin-allergic patients: Clindamycin, erythromycin, azithromycin
	Periauricular area
	Ciprofloxacin, 500 mg/12 h po

Treatment of Postsurgical Superinfection

Prophylaxis during surgery involves administration of antibiotics in a single dose 30 to 60 minutes before the operation, although it can continue for 7 to 10 days if the patient is at high risk of postoperative superinfection.

Patients in whom this type of infection is likely have usually undergone the following procedures: nasal grafts or flaps; high-tension closure; surgery involving very sebaceous nasal tissue, or skin that is inflamed, infected, or with cysts; multiple simultaneous procedures; surgery below the knee; and surgery of the hand[3,5,15,16] (Table 2).

Cephalexin can be used in these situations and continued after the presurgical dose with 500 mg at 1 g/12 hours or cloxacillin at 500 mg/6 hours. Both offer good coverage of gram-positive entities and activity against common gram-negative entities.[17]

In penicillin-allergic patients, the alternatives are clindamycin and the macrolides (eg, erythromycin and azithromycin).

When there is a high suspicion of infection by *Pseudomonas* or other gram-negative microorganisms, especially if the ear is involved, oral ciprofloxacin is recommended at 500-1000 mg daily, although quinolone-resistant *Pseudomonas* has been reported.[17]

Cultures should be taken if exudate is evident or there is formation of abscesses, which should be opened and drained.

Prophylaxis of Endocarditis

Although the incidence of bacteremia in cutaneous surgery is low—approximately 2.8%—it is particularly worrying in patients at high risk of endocarditis. Specific endocarditis prophylaxis requires adherence to the 1997 AHA recommendations, which classify patients according to their risk status (high, moderate, or low) (Table 3).

Prophylaxis should not be used in cutaneous procedures carried out on noninflamed clean skin, not even in high-

risk patients, such as those with prosthetic valves, a history of endocarditis, or complex cyanotic congenital heart disease.[2,3,5,16]

When surgery involves the mucosa, the center of the face, and the genitals (especially in the case of Mohs surgery), the risk of bacteremia is higher; therefore, antibiotic prophylaxis is recommended, even when unbroken skin is involved.[3,5]

Mohs surgery sometimes requires long interventions; therefore, high-risk patients should be given antibiotic prophylaxis, even if the procedure involves unbroken skin.[5,16]

When the surgical field is infected (incision or drainage of abscesses), appropriate antibiotic therapy should be started and the intervention postponed. If this is not possible, prophylaxis for endocarditis should be used.

The most frequent causal agents of endocarditis are *S pyogenes*, *S aureus*, and *S epidermidis* in surgery of the head and neck, and *S viridans* when the oral mucosa is involved. Enterococci and gram-negative bacteria can cause endocarditis when they affect the genitals.

The antibiotic should be administered 30 to 60 minutes before the procedure with no need for a second dose after surgery.[3] The first-choice drug for surgery involving the oral mucosa is amoxicillin (2 g po). If oral administration is not possible, ampicillin (2 g intramuscularly or intravenously) can be used. Several options are available for penicillin-allergic patients: clindamycin (600 mg), cephalexin or cefadroxil (2 g)—although the cephalosporins should not be used in penicillin-allergic patients who have had type I reactions—and azithromycin or clarithromycin (500 mg). Penicillin-allergic patients who cannot receive medication orally can be administered clindamycin (600 mg) or cephazolin (1 g).

If the procedure does not involve the oral mucosa, the antibiotic of choice is cephalexin.

Erythromycin is a commonly used alternative in penicillin-allergic patients, although the AHA currently recommends azithromycin in its place as it induces fewer gastrointestinal effects.

Given the resistance of enterococci to several oral antibiotics, high-risk patients undergoing surgery of the

Table 3. Prophylaxis of Infectious Endocarditis in Dermatologic Surgery

Indications	Patients at high risk of infectious endocarditis (valvular devices, history of endocarditis, complex cyanotic congenital heart disease) in the case of the following:	
	Surgery involving the mucosa, center of the face, or genitals	
	Mohs surgery	
Drugs	*First Choice*	*Penicillin-Allergic Patients*
	Oral Mucosa	
	Oral	Oral
	Amoxicillin, 2 g	Clindamycin, 600 mg
	Intravenous/intramuscular	Azithromycin, 500 mg
	Ampicillin, 2 g	Clarithromycin, 500 mg
		Intravenous
		Clindamycin, 600 mg
	Skin (Except Genital Area)	
	Oral	Oral
	Cephalexin, 2 g	Azithromycin, 500 mg
		Erythromycin, 1 g
	Genital Area	
	Oral	
	Clindamycin, 600 mg before surgery and at 6 hours after	
	Intravenous/intramuscular	
	Cephazolin, 1 g before surgery and 6 hours after	
	Clindamycin, 600 mg before surgery and 6 hours after	

genital area should be given intramuscular or intravenous antibiotic therapy (cephazolin and clindamycin) with a second dose at 6 hours. Vancomycin is recommended for penicillin-allergic patients.

Clindamycin and azithromycin are probably the best choice if the dermatologist wants to cover *S aureus* when prophylaxis is prescribed. Cloxacillin covers gram-positive microorganisms, specifically *S aureus*, but no studies support its use as prophylaxis of endocarditis.[3]

Prophylaxis of Orthopedic Device Infection

Some patients are considered high risk because of a possible infection of their orthopedic device by hematologic seeding. These patients are immunosuppressed (rheumatoid arthritis, systemic lupus erythematosus, medication- or radiotherapy-induced immunosuppression) or have insulin-dependent diabetes, less than 2 years have elapsed since replacement, and previous device infection, malnutrition, or hemophilia has been reported.

In 1997, the AHA established that antibiotic prophylaxis would only be indicated in dental procedures in patients with total joint prostheses and concluded that antibiotic prophylaxis is not indicated for those patients whose joint prosthesis had not been in place for more than 2 years and who did not fulfill the criteria for high risk.

Given that the incidence of bacteremia associated with cutaneous surgery is considered low—approximately 2.8%—the decision to administer antibiotic prophylaxis to high-risk patients depends on the joint criteria of the surgeon and orthopedic specialist.[3]

Prophylaxis of Infection of Other Types of Implants

Advances in medicine mean that more and more "foreign bodies" are being implanted. These include pacemakers, internal defibrillators, vascular and ventriculoperitoneal shunts, and neurotransmitters.

Since 1997, the AHA has not recommended antibiotic prophylaxis for patients with internal defibrillators or pacemakers.

Infection of ventriculoperitoneal shunts during cutaneous surgery seems unlikely, although prophylaxis should perhaps be used if the mucosa are involved.

In patients with vascular grafts or arteriovenous fistulas, surgery should be postponed for 6 to 12 months if possible. Ceftriaxone is effective at preventing infection, although it is not an absolute indication; therefore, the vascular surgeon should be consulted.[3]

Conclusions

1. The indications for antibiotic prophylaxis in dermatologic surgery are as follows: *a)* it is not necessary when uncontaminated clean skin is involved; *b)* depending on environmental and patient-related factors (eg, reduced immune status), it can be applied when the procedure involves contaminated clean skin; *c)* it is very useful in procedures involving contaminated skin (eg, lesions with nonpuruluent acute inflammation); *d)* it is clearly indicated when there are infected areas and foreign bodies, devitalized tissue, and tumors with necrotic or purulent material.
2. The antibiotic of choice is cephalexin at 2 g when administered orally, and cephazolin at 1 g when administered intravenously. Penicillin-allergic patients should receive erythromycin, which is tending to be replaced by azithromycin or clarithromycin. These agents are administered 30 to 60 minutes before the procedure.
3. The use of topical antibiotics is not clearly justified, although in daily practice (and based on comparative studies of other processes) it may prove useful with sutures in some cases, and it could replace systemic therapy.
4. AHA recommendations should be followed when administering prophylaxis for endocarditis.
5. In general, prophylaxis for infection of orthopedic devices and other types of implant does not seem necessary, although the corresponding specialists should be consulted in cases involving high-risk patients.
6. Lastly, antibiotic prophylaxis should not be used to support poor surgical technique. The surgeon should combine speed with sound technique. This includes careful handling of tissue, good hemostasis, avoidance of dead spaces, minimal tissue devitalization, and appropriate use of sutures and electrocautery.

Conflicts of Interest
The authors declare no conflicts of interest.

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