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Preventing Complications in Dermatologic Surgery: Pre-surgical Concerns

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Abstract

Cutaneous surgery has become critical to comprehensive dermatologic care, and dermatologists must therefore be equipped to manage the risks associated with surgical procedures. As complications may occur at any point along the continuum of care, assessing, managing and preventing risk from beginning to end becomes essential. This review focuses on preventing surgical complications pre- and post-operatively as well as during the surgical procedure.

Keywords

dermatologic surgery; dermatologic surgery complications; preventing surgical complications; cryosurgery; anticoagulation medication; antibiotic prophylaxis; patient consent; antiseptic; local anesthetic

Patient Selection

Key points

- Assessing patient and tumor characteristics can optimize treatment approach.

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- Non-surgical modalities are alternatives for poor surgical candidates or low-risk tumor types and have varying efficacy.

The standard treatments for low- and high-risk non-melanoma skin cancers (NMSC) are excision with post-operative margin assessment and Mohs micrographic surgery (MMS), respectively. Randomized trials and meta-analyses have established the efficacy of surgery compared to non-surgical treatment modalities for NMSCs.[1–5]

Electrodesiccation and curettage (ED&C) is a cost-effective first-line treatment for selected small, nonaggressive NMSCs.[6–8] While few trials report post-ED&C recurrence rates, one prospective study documented 5-year recurrence rates of approximately 5%, compared to 3.5% after excision, and 2.1% after MMS.[9] A major drawback includes lack of histologic margin confirmation. Treatment with ED&C should be limited to primary, small, well-defined tumors.[10] For midfacial NMSCs, surgical excision and MMS can provide better cosmesis. ED&C is not recommended for NMSCs along embryonic fusion planes (medial canthi, nasolabial folds, nasal alae), as recurrent tumor buried beneath scar tissue is harder to treat.[11]

High-risk patients who are poor candidates for extensive surgery or with high risk tumors necessitating adjuvant therapy should be considered for radiotherapy (RT), including superficial or orthovoltage RT, electron beam therapy or dose-rate brachytherapy.[8,12,13] Protocols vary and can be modified based on age, although dosage generally ranges from 3 to 5 Gy three to five times weekly for a total of 50–70 Gy. Reported 5-year cure rates are 92% for BCC and 80% for SCC.[14] RT is contraindicated in patients with connective tissue disease or genodermatoses that increase susceptibility to skin cancer(s).

Photodynamic therapy (PDT) is not recommended for invasive SCC but may be efficacious for low risk basal cell carcinoma (BCCs) and squamous cell carcinoma in situ (SCCIS). BCCs treated with PDT may show initial tumor clearance but can have high recurrence rates on longterm follow up, depending on histopathologic subtype.[15] Superficial, rather than nodular or infiltrative, BCCs may demonstrate improved responses to PDT likely due to limited penetration of ALA and light into the deeper dermis.[16] Greater number of treatments with PDT may be associated with improved response rates.[14] Curettage before PDT may improve cure rates. Similarly, curettage before cryotherapy may produce higher cure rates. High cure rates (>90%) with cryotherapy have been reported although in published literature, tumor characteristics were not uniform and methods used may be impractical (e.g. multiple freezes at >60 seconds duration) and widely variable. [16, 17–21]

Topical chemotherapies, including imiquimod and 5-fluorouracil (5-FU), are not recommended for SCC but can be used for low risk BCCs.[6,7,19] A recent five-year randomized control trial demonstrated increased efficacy with imiquimod over 5-FU for superficial BCCs.[22] PDT has also shown inferior efficacy to 5-FU for superficial BCC.[22]

Locally advanced or metastatic BCCs can be treated with hedgehog inhibitors, including vismodegib [23] and sonedegib.[24] The international open label STEVIE trial demonstrated objective response rates of 68.5% for patients with locally advanced disease, with about half exhibiting complete response and half exhibiting partial response.[25] Vismodegib has also

been used as neoadjuvant treatment,[26] producing a 35% reduction in surgical defect size in clinical trials.[27]

While theoretical concern exists regarding the risk of skip lesions affecting surgical margin integrity in patients treated with vismodegib, Soon et al. showed that with wide-margin MMS post-vismodegib, no patients had skip areas on pathologic evaluation.[28]

Locally advanced or metastatic SCC can be treated with surgical resection with or without adjuvant radiation or with epidermal growth factor inhibitors and cisplatin, as single agents or in combination.[7] More recently, immunotherapies including pembrolizumab and cemiplimab offer new options for patients with locally advanced cutaneous and metastatic SCC.[29,30]

Special Patient Characteristics

Key points

- Allergies should be identified early to prevent and manage potential reactions.
- Special patient populations necessitate specific preoperative planning.

A history of allergic reactions should be elicited preoperatively, particularly to anesthetics, latex, antiseptics, wound dressings, and oral and topical antibiotics.[31,32] Minor reactions to local anesthetics (LA) include type IV delayed contact dermatitis which usually results from exposure to topical antibiotics, antiseptics or wound dressings. True type I IgE mediated anaphylaxis to LA is rare (<1%)[33] Anaphylaxis to preservatives within LA, or other concomitant exposures including antibiotics or latex, are more common than true LA reactions.[34] If concern for true type I allergy exists, the patient should be referred to an allergist for pre-surgical testing of alternatives, which may include preservative-free lidocaine, prilocaine, or bupivacaine, as there is limited amide cross-reactivity.[35] Other alternatives include tumescent anesthesia with normal saline, benzyl alcohol, or diphenhydramine.[36] Type I latex allergy can range from mild (urticaria) to rare severe reactions (angioedema or anaphylaxis). Vinyl, nitrile, or latex free gloves should always be available.

Thorough investigation of medical comorbidities and medications (including supplements) can help guide surgical planning. Elderly patients may experience benign essential tremors, musculoskeletal issues, or cognitive decline that complicate peri-operative and post-operative care.[37] While intraoperative bleeding due to hypertension can slightly increase operative times, a study of elderly patients undergoing Mohs surgery demonstrated that mild to moderate hypertension did not pose a significant risk and should not prevent or delay surgery.[38] In cases of severe hypertension, cardiology guidelines recommend considering a delay for elective major surgery.[39] Generally, patients with three or more blood pressure measurements above 180/110 mm Hg over one hour should postpone surgery to allow further evaluation.37

Appropriate preoperative preparation for pregnant patients increases the likelihood of safe, successful surgery. Surgery is safest during the second trimester (weeks 13–24)

or post-partum, but should not be delayed for high risk cutaneous malignancies such as melanoma.[40] Maternal positioning in the left lateral tilt position of 30° using a wedge or pillow under the hip or between the knees can prevent inferior vena cava compression and fetal oxygen compromise.[40] Chlorhexidine and alcohol are safe antiseptics, while iodine and hexachlorophene have reported associations with fetal hypothyroidism and teratogenesis, respectively.[40,41] Small locally administered doses of lidocaine and epinephrine are generally considered safe if not injected intravascularly, as endogenous epinephrine release during times of stress is greater than what would be introduced via injection during cutaneous surgery.[40,41]

Antithrombotic Medications

Key points:

- Antithrombotics rarely require discontinuation before dermatologic surgery.
- In the setting of large repairs, discussion with the prescribing provider regarding whetherto continue newer oral anticoagulants is appropriate.

Prescription medications, over-the-counter drugs, and herbal supplements can all impair clotting (Table 1), and approximately 25–38% of dermatologic surgery patients take antithrombotic medications.[42–44] Early studies showed a non-significant difference in postoperative bleeding in patients taking aspirin, warfarin, or nonsteroidal anti-inflammatory drugs (NSAIDs) versus controls, while intra-operative bleeding was either non-significant or easily controlled.[45–47] Larger systematic analyses have confirmed the lack of significant increase in complications for patients on aspirin or NSAIDs compared to controls during cutaneous surgery.[48,49] In contrast, increased bleeding complications have been demonstrated in patients taking warfarin.[48,49] To address this risk, the international normalized ratio (INR) should be checked preoperatively. Procedures in patients with values >3.5 may be delayed to minimize risk of hemorrhage.[50,51]

The thienopyridines (clopidogrel, ticlopidine, prasugrel) are potent irreversible platelet inhibitors. Prospective studies documented increased bleeding in patients taking clopidogrel during dermatologic surgery, but complications were manageable and without sequelae[44,52] Even for patients taking both clopidogrel and warfarin whose relative risk of bleeding is increased, the absolute risk of bleeding is still low.[44] Thus, continuing antiplatelet medications is recommended.

Newer oral anticoagulants (NOACs), including dabigatran, rivaroxaban, and apixaban have become more common.[51] Patients taking NOACs may experience more postoperative bleeding than those taking traditional anti-coagulants; however, such complications are generally rare and mild.[53,54] In rare instances, hematomas have developed in patients on NOACs requiring large repairs. These patients may benefit from simpler repairs and avoiding large flaps when possible. When a large repair cannot be avoided, particular attention to peri-operative hemostasis and/or pre-operative discussion with the patient and other providers may help guide decision-making with respect to the risks and benefits of cessation.[55]

In general, dermatologic surgery patients should be instructed to continue antithrombotic medications as the risks of bleeding (i.e.: post-operative hematoma) are small, manageable and have lower risk for morbidity than thromboembolic events.[51,56] Individualized patient risk management may be required, allowing procedure type and patient factors to guide decision-making along with discussion with the primary prescriber.[57,58] Meticulous intraoperative hemostasis, minimizing undermining, pressure dressings, and patient education can maximize patient safety and minimize bleeding risk.[42,45]

Pre-surgical Identification of Patients at Increased Infection Risk

Key points:

- The American Heart Association (AHA) has redefined patients at greatest risk for post-surgical infections, limiting use of antibiotic prophylaxis.
- Patients with indwelling devices such as prosthetic joints are at greater risk for infection,although guidelines do not recommend routine antibiotic prophylaxis.

There is a low risk of significant bacteremia in dermatologic procedures, supporting the recommendation of conservative antibiotic prophylaxis use.[59–61] However, patients at higher risk for surgical site infection (SSI), endocarditis and/or contamination of prosthetic joints deserve special consideration when the surgical site is infected or when mucosal sites are involved.[60,62,63] High-quality guidelines based on dermatologic surgery are lacking, and have mostly been adapted from the dental literature.

The AHA redefined cardiac patients at high risk for infection from dental procedures in their latest guidelines (Table 2), eliminating about 90% of patients for whom antibiotic prophylaxis had previously been recommended.[62] Additionally, updated guidelines do not recommend prophylaxis for indwelling devices such as cardiac pacemakers and internal defibrillators.[64] Pathogen directed prophylaxis guidelines are summarized in Table 3.[60] The American Academy of Orthopedic Surgeons (AAOS) with the American Dental Association (ADA) published guidelines for dental patients with total joint replacement,[63] which have been extrapolated to dermatologic procedures. Recent updates recommend discontinuation of routine prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures.[65,66] In summary, no antibiotic prophylaxis is required for patients with cardiac disease or total joint replacement, if the repair is uncomplicated and performed on a non-infected and non-mucosal site.

Recent studies have refuted the notion that certain repairs (e.g. grafts) and sites (e.g. below the knee) have higher SSI rates.[67,68] However, SSI prophylaxis should be considered on an individual basis depending on patient factors such as bacterial colonization (e.g. severe atopic dermatitis), smoking status, comorbidities including diabetes or immunosuppression, lesional factors such as proximal infection, and risk of morbidity should wound infection occur. If antibiotic prophylaxis is given, the World Health Organization (WHO) recommends dosing within 120 minutes pre-procedure to prevent SSIs; prolonged prophylactic antibiotics after surgery are not recommended.[68] Indiscriminate antibiotic use should be discouraged as it increases risk of adverse events including drug reactions and antimicrobial resistance.[66,67]

Surgical Site Preparation

Key points:

- When choosing an antiseptic, considerations include onset and duration of action, spectrum of coverage, efficacy, and toxicity.
- Chlorhexidine gluconate has been shown to be more efficacious in preventing SSI thaniodophor compounds.

Commonly used preoperative skin antiseptic preparations include isopropyl alcohol, povidoneiodine (PI) and chlorhexidine gluconate (CHG). Qualities to consider when choosing an antiseptic include onset and duration of action, spectrum of coverage, efficacy, and toxicity.[69,70] The method of skin application has not demonstrated any impact on preventing SSIs.[71]

Alcohol is fast-acting and effective against gram-positive and gram-negative bacteria, fungi, and viruses, but ineffective against spores.[72] Its disadvantages include short duration of effect and flammability when in range of a heat-producing device, posing a risk during electrosurgery.[73,74] Combining alcohol with iodophors or CHG increases efficacy and duration of action compared to antisepsis with alcohol only.[75,76]

The damaging effect of iodine on protein and DNA gives it its antimicrobial properties.[70,77] PI is effective against gram-positive and gram-negative bacteria, yeast, some bacterial spores, protozoa, and viruses including human immunodeficiency virus (HIV) and hepatitis B (HBV).[73,77,78] Limitations include risk for contact dermatitis in iodine sensitive patients, inactivation by organic material such as body fluids, and potential for systemic toxicity.[73]

CHG has broad efficacy against gram-positive and gram-negative bacteria, many viruses and fungi.[72] Contamination with organic products does not inactivate it. It is known to be ototoxic and oculotoxic, and PI can be a safe alternative.[72,79] However, a multicenter study suggested that CHG's can safely be used on facial sites not involving eyes and ears assuming careful application.[80] Notably, the FDA released a warning that patients with mild contact reactions to CHG may develop contact anaphylaxis with re-exposure, highlighting the importance of thorough history-taking.[81] Manifestations may begin with hives, facial swelling, or difficulty breathing, and can progress to anaphylactic shock.

Parachlorometaxylenol (PCMX), also known as chloroxylenol, is a CHG alternative that can be safely used on periocular and periotic sites, with similar but less efficacious anti-microbial activity compared to CHG.[82] PCMX is known to have poor pseudomonal coverage, but is frequently formulated with additive ethylenediaminetetraacetic acid (EDTA) to improve antipseudomonal activity.

While literature from other surgical specialties has mixed evidence on whether iodophor- or CHG-based preparations are more effective at preventing SSIs,[83–86] a recent meta-analysis demonstrated that antisepsis with CHG is associated with greater reduction in SSI incidence compared to iodophor compounds.[87] A survey of Mohs surgeons found that CHG is their

most commonly used skin antiseptic except during periocular procedures, when PI is more often used.[88]

Anesthetics

Key points:

- Local anesthetics play an important role in dermatologic procedures.
- Recognizing the signs of lidocaine toxicity can facilitate appropriate management.

The safety of intradermal lidocaine with epinephrine in dermatologic surgery has recently been confirmed with no reports of serious adverse events in a large patient population with advanced age and comorbidities.[89] However, toxicity can occur when maximum allowable doses are exceeded, and it is imperative to be aware of dosage guidelines. The maximum dose of plain 1% lidocaine should not exceed 5 mg/kg (or 300 mg total), while the dose of 1% lidocaine with epinephrine should not exceed 7mg/kg (or 500 mg total).[90]

Systemic toxicity of lidocaine with epinephrine includes effects on the central nervous system (CNS), cardiovascular system, and skin.[91] CNS effects include drowsiness, perioral numbness, tongue tingling, tinnitus, diplopia, and metallic taste, progressing to slurred speech, seizures, and muscle twitching, and eventually to respiratory arrest.[90] Lidocaine can affect the cardiovascular system by causing myocardial depression, increased conduction time, hypotension, hypoxia, acidosis, and bradycardia. Epinephrine can cause tachycardia, palpitations, hypertension, or chest pain. Side effects of lidocaine and epinephrine along with treatment strategies are presented in Table 4. Of note, patients may also metabolize local anesthetics at a higher rate or may experience reduced efficacy.[92]

Preventing wrong-site procedures

Key points:

- Wrong-site procedures (WSP) are a leading cause of serious errors in dermatologicsurgery.
- Specific protocols should be implemented to prevent WSP.

Dermatologists performing cutaneous surgery should institute checklists and stringent quality assurance policies to reduce preventable errors. WSPs are the leading cause of serious errors in dermatologic surgery according to a dermatologist reported survey of 150 responses; these errors can lead to malpractice litigation.[93,94]

Several issues may complicate adequate site identification including: biopsy sites on difficult to visualize anatomic areas, sites with previous procedures or extensive field damage, time lag between biopsy and consult or treatment, inadequate documentation or lack of photographs by the referring provider, and patients' inability to accurately recall biopsy site(s), especially among the elderly.[95–98] Rossi and Lawrence found that the most significant factor associated with patients' inability to identify their biopsy site was lack of

site visibility.[99,100] One prospective study found that patients with multiple biopsies in one visit and a greater than 6-week time lapse between biopsy and surgery had an increased risk of site misidentification.[100] Awareness of WSP risk factors should guide the practices of referring providers.

High quality photography is useful in mitigating WSP. As many as one fourth of patients undergoing dermatologic surgery, and one fifth of providers performing it, may have difficulty identifying biopsy sites without photography.[96,101,102] Having a biopsy site photograph is associated with a significant reduction in postponed surgeries and increased patient confidence in site identification.[100] Although 89% of 325 Mohs surgeons surveyed considered high-quality photography most useful in aiding site identification, 25% or fewer of their referring physicians provided them.[97] This statistic should alert referring physicians to the importance of photography prior to biopsy, and the need to transmit high quality, color images when referring patients to other providers for surgery. It may be helpful to integrate consent for image transmission at the time of biopsy consent, using an easy, HIPAA compliant transmission method to send color photographs. Newer electronic medical record software, such as EMA,™ can facilitate seamless integration of photography into the work-flow.[103] However, this can be a financial, technical and logistical challenge. In cases where a physician is unable to provide high-quality photography, documenting a specific anatomic site on the pathology report may be critical (for example, listing anatomic site as right scaphoid fossa rather than right ear).[97] Creating a work-flow in which the physician, rather than an assistant, is responsible for documenting anatomic site may also facilitate accurate and specific localization.

Finally, technology can affordably and easily assist in accurate site identification. To capitalize on the lag time between biopsy and surgery scheduling, Nijhawan et al. had office staff, when scheduling patient appointments for Mohs consultation, ask that patients take “selfie”, or selfacquired, photographs of their unhealed biopsy site and e-mail them before the appointment or bring them to their consultation.[96] Providers can also suggest that patients take such photographs on their personal phones at the time of biopsy. More recently, others have suggested FaceTime video-chat to confirm anatomic site with the referring provider, which is HIPAA compliant if both parties are using WPA2 Enterprise Wi-Fi.[98]

Starling and Coldiron implemented a protocol involving re-biopsy if a surgical site was in question, which yielded no wrong-site surgeries in 7,983 Mohs cases over six years.[104] Dermatologic surgeons and referring providers can implement such methods to minimize WSP and optimize patient safety.

Conclusion

Pre-surgical patient evaluation is critical to the success of cutaneous surgery. By managing the risks involved in patient selection, care of special populations, antithrombotic use, surgical site infection, antiseptic choice, anesthetic use, and correct surgical site identification, dermatologists can make the evidence-based decisions necessary to prepare their patients for surgery, minimize their risk of complications and optimize their safety.

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Table 1:

Anticoagulation agents listed by category.

Anticoagulation Agents		
Prescription Medications	**Over-the-Counter Drugs**	**Foods/Herbal Supplements**
Clopidogrel Ticlopidine Dabigatran Warfarin LMWH Rivaroxaban Argatroban Apixaban Edoxaban	Aspirin NSAIDs	Fish oil, garlic, ginger, ginkgo, ginseng, feverfew, licorice, danshen

Abbreviations: NSAIDs = non-steroidal anti-inflammatory drugs; LMWH = low molecular weight heparin

Table 2:

Conditions that require versus those that no longer require pre-procedure antibiotic prophylaxis.

REQUIRE PROPHYLAXIS	NO LONGER REQUIRE PROPHYLAXIS
Prosthetic cardiac valves	Mitral valve prolapse
History of infective endocarditis	Rheumatic heart disease
Cardiac transplant patients with cardiac valvular disease	Bicuspid valve disease
Cardiac valve repairs with prosthetic material or device that has been repaired in the past 6 months	Calcified aortic stenosis
Unrepaired congenital heart defects (including palliative shunts and conduits)	Congenital heart conditions (ventricular septal defect, atrial septal defect, and hypertrophic cardiomyopathy)
Repaired congenital heart defect with residual defect at or adjacent to the site of prosthetic path or device	

Table 3.

Antibiotic prophylaxis regimens and their indications

Indication	Main pathogen(s) of concern	Antibiotic(s)	Dosage(s)
Prophylaxis for infective endocarditis	Staphylococci Streptococci	Amoxicillin	2 g po adults and 50 mg/kg po children
Prophylaxis for contaminated surgical site	Staphylococcus *aureus* Beta-hemolytic Streptococcus	Amoxicillin	2 g po adults and 50 mg/kg po children
Prophylaxis for newly implanted prosthetic cardiac valves or prophylaxis for possible infection with S. epidermidis or MRSA	Staphylococcus *epidermidis* MRSA	Vancomycin	1 g IV adults
Prophylaxis for oral pathogen infection	Streptococcus *viridans*	Amoxicillin	2 g po adults and 50 mg/kg po children
Prophylaxis for high risk hematogenous joint infection	Staphylococcus *aureus* Staphylococcus *epidermidis*	Amoxicillin	2 g po adults and 50 mg/kg po children
Prophylaxis for patients who are penicillin allergic	Staphylococcus Streptococcus	Cephalexin	2 g adults and 50 mg/kg po children
		Clindamycin	600 mg adults and 20 mg/kg children
		Azithromycin	500 mg adults and 15 mg/kg children
		Clarithromycin	500 mg adults and 15 mg/kg children
Prophylaxis for patients who cannot take po medications	Staphylococcus Streptococcus	Ampicillin	2 g IM/IV adults and 50 mg/kg IM/IV children
		Cefazolin	1 g IM/IV adults and 50 mg/kg IM/IV children
		Ceftriaxone	1 g IM/IV adults and 50 mg/kg IM/IV children
Prophylaxis for patients who are penicillin allergic and cannot take po medications	Staphylococcus Streptococcus	Clindamycin	600 mg IV/IM adults and 20 mg/kg children
		Cefazolin	1 g IM/IV adults and 50 mg/kg IM/IV children
		Ceftriaxone	1 g IM/IV adults and 50 mg/kg IM/IV children

Table 4:

Potential adverse events of lidocaine and epinephrine

Clinical Symptom	Management Strategy
Lidocaine	
Allergy (anaphylaxis, difficulty breathing, angioedema, urticaria, pruritus)	Airway maintenance (oxygen), antihistamines, subcutaneous epinephrine, steroids
Central nervous system (drowsiness, circumoral numbness, metallic taste, tingling, slurred speech, blurred vision, double vision, seizure, respiratory arrest)	Intravenous (IV) diazepam, airway maintenance
Cardiovascular system (bradycardia with worsening myocardial depression, arteriovenous (AV) block, low blood pressure, hypoxia, acidosis)	Airway maintenance, cardiopulmonary resuscitation (CPR), pressors, IV fluids
Epinephrine	
Cardiovascular system (increased heart rate, chest pain, palpitations, high blood pressure)	Vasodilators