Preventing complications in dermatologic surgery: Presurgical concerns

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Learning objectives
After completing this learning activity, participants should be able to identify the proper necessary pre-surgical concepts and procedures to optimize the overall patient surgical experience and to prevent avoidable poor outcomes; identify characteristics of patients who may not be good surgical candidates and describe alternative surgical treatments; describe how to surgically manage patients on antithrombotic medications, identify patients at increased risk of surgical infections; describe proper surgical site preparation and explain use of and risks associated with local anesthetics as well as explain methods to help prevent wrong-site procedures.

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Cutaneous surgery has become critical to comprehensive dermatologic care, and dermatologists must therefore be equipped to manage the risks associated with surgical procedures. Complications may occur at any point along the continuum of care, and therefore assessing, managing, and preventing risk from beginning to end becomes essential. This review focuses on preventing surgical complications pre- and postoperatively as well as during the surgical procedure. (J Am Acad Dermatol 2021;84:883-92.)

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

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Abbreviations used:

BCC:	basal cell carcinoma
CHG:	chlorhexidine gluconate
ED&C:	electrodesiccation and curettage
LAs:	local anesthetics
MMS:	Mohs micrographic surgery
NMSCs:	nonmelanoma skin cancers
PDT:	photodynamic therapy
PI:	povidone-iodine
RT:	radiotherapy
SCC:	squamous cell carcinoma
SSI:	surgical site infection
WSPs:	wrong-site procedures

PATIENT SELECTION

Key points

- Assessing patient and tumor characteristics can optimize the treatment approach
- Nonsurgical modalities are alternatives for poor surgical candidates or patients with low-risk tumor types and have varying efficacy

The standard treatments for low- and high-risk nonmelanoma skin cancers (NMSCs) are excision with postoperative margin assessment and Mohs micrographic surgery (MMS), respectively. Randomized trials and meta-analyses have established the efficacy of surgery compared with nonsurgical 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, 1 prospective study documented 5-year recurrence rates of approximately 5% compared with 3.5% after excision and 2.1% after MMS.[9] A major drawback includes the 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 (ie, the medial canthi, nasolabial folds, and nasal alae) because a recurrent tumor buried beneath scar tissue is harder to treat.[11]

High-risk patients who are poor candidates for extensive surgery or who have 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 to 70 Gy. Reported 5-year cure rates are 92% for basal cell carcinoma (BCC) and 80% for squamous cell carcinoma (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 BCC and SCC in situ. BCCs treated with PDT may show initial tumor clearance but can have high recurrence rates on long-term follow-up, depending on the histopathologic subtype.[15] Superficial, rather than nodular or infiltrative, BCCs may have improved responses to PDT likely because of the limited penetration of 5-aminolevulinic acid and light into the reticular dermis.[16] A 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 the published literature tumor characteristics were not uniform and the methods used may be impractical (eg, multiple freezes at >60 seconds duration) and widely variable.[10,16-20]

Topical chemotherapies, including imiquimod and 5-fluorouracil, are not recommended for invasive SCC but can be used for low risk BCCs (and possibly SCC in situ).[6,7,10,16] A recent 5-year randomized control trial demonstrated increased efficacy with imiquimod over 5-fluorouracil for superficial BCCs.[21] PDT has shown inferior efficacy to 5-fluorouracil for superficial BCC.[21]

Locally advanced or metastatic BCCs can be treated with hedgehog inhibitors, including vismodegib[22] and sonedegib.[23] 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.[24] Vismodegib has also been used as neoadjuvant treatment,[25] producing a 35% reduction in surgical defect size in clinical trials.[26] While theoretical concern exists regarding the risk of skip lesions affecting surgical margin integrity in patients treated with vismodegib, Soon et al[27] showed that with wide-margin MMS post vismodegib, no patients had skip areas on pathologic evaluation.

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.[28,29]

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.[30,31] Minor reactions to local anesthetics (LAs) include type IV delayed contact dermatitis, which usually results from exposure to topical antibiotics, antiseptics, or wound dressings. True type I immunoglobulin E–mediated anaphylaxis to LA is rare (<1%).[32] Anaphylaxis to preservatives within LA, or other concomitant exposures, including antibiotics or latex, are more common than true LA reactions.[33] If concern for true type I allergy exists, the patient should be referred to an allergist for presurgical testing of alternatives, which may include preservative-free lidocaine, prilocaine, or bupivacaine because there is limited amide cross-reactivity.[34] Other alternatives include tumescent anesthesia with normal saline, benzyl alcohol, or diphenhydramine.[35] 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.

A 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 perioperative and postoperative care.[36] While intraoperative bleeding caused by hypertension can slightly increase operative times, a study of elderly patients undergoing MMS found that mild to moderate hypertension did not pose a significant risk and should not prevent or delay surgery.[37] In cases of severe hypertension, cardiology guidelines recommend considering a delay for elective major surgery.[38] Generally, patients with ≥3 blood pressure measurements >180/110 mm Hg over 1 hour should postpone surgery to allow further evaluation.[36]

Appropriate preoperative preparation for pregnant patients increases the likelihood of safe, successful surgery. Surgery is safest during the second trimester (weeks 13-24) or postpartum, but should not be delayed for high-risk cutaneous malignancies, such as melanoma.[39] 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.[39] Chlorhexidine and alcohol are safe antiseptics, while iodine and hexachlorophene have reported associations with fetal hypothyroidism and teratogenesis, respectively.[39,40] Small locally administered doses of lidocaine and epinephrine are generally considered safe if not injected intravascularly, because endogenous epinephrine release during times of stress is greater than what would be introduced via injection during cutaneous surgery.[39,40]

ANTITHROMBOTIC MEDICATIONS

Key points

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

Prescription medications, over-the-counter drugs, and herbal supplements can all impair clotting (Table I), and approximately 25% to 38% of patients undergoing dermatologic surgery take antithrombotic medications.[41-43] Early studies showed a nonsignificant difference in postoperative bleeding in patients taking aspirin, warfarin, or nonsteroidal anti-inflammatory drugs versus control subjects, while intraoperative bleeding was either nonsignificant or easily controlled.[44-46]

Larger systematic analyses have confirmed the lack of significant increase in complications for patients taking aspirin or nonsteroidal anti-inflammatory drugs compared with control subjects during cutaneous surgery.[47,48] In contrast, increased bleeding complications have been shown in patients who are taking warfarin.[47,48] To address this risk, the international normalized ratio should be checked preoperatively. Procedures in patients with values >3.5 may be delayed to minimize the risk of hemorrhage.[49,50]

The thienopyridines (clopidogrel, ticlopidine, and prasugrel) are potent irreversible platelet inhibitors. Prospective studies documented increased bleeding in patients who were taking clopidogrel during dermatologic surgery, but complications were manageable and without sequelae.[43,51] Even for patients taking both clopidogrel and warfarin whose relative risk of bleeding is increased, the absolute risk of bleeding is still low.[43] Thus, continuing antiplatelet medications is recommended.

Newer oral anticoagulants, including dabigatran, rivaroxaban, and apixaban, have become more common.[50] Patients taking newer oral anticoagulants may experience more postoperative bleeding than those taking traditional anticoagulants; however, such complications are generally rare and mild.[52,53] In rare instances, hematomas have developed in patients on newer oral anticoagulants requiring large

Table I. Anticoagulation agents listed by category

Category	Agent
Prescription medications	Clopidogrel, ticlopidine, dabigatran, warfarin, LMWH, rivaroxaban, argatroban, apixaban, and edoxaban
Over-the-counter drugs	Aspirin and NSAIDs
Foods/herbal supplements	Fish oil, garlic, ginger, ginkgo, ginseng, feverfew, licorice, and danshen

LMWH, Low molecular weight heparin; *NSAID*, nonsteroidal anti-inflammatory drug.

repairs. These patients may benefit from simpler repairs and avoiding large flaps when possible. When a large repair cannot be avoided, particular attention to perioperative hemostasis or preoperative discussion with the patient and other providers may help guide decision-making with respect to the risks and benefits of cessation.[54]

In general, patients undergoing dermatologic surgery should be instructed to continue antithrombotic medications as the risks of bleeding (i.e., postoperative hematoma) are small, manageable, and have a lower risk for morbidity than thromboembolic events.[50,55] Individualized patient risk management may be required, allowing procedure type and patient factors to guide decision-making along with discussion with the primary prescriber.[56,57] Meticulous intraoperative hemostasis, minimizing undermining, pressure dressings, and patient education can maximize patient safety and minimize bleeding risk.[41,44]

PRESURGICAL IDENTIFICATION OF PATIENTS AT INCREASED RISK OF INFECTION

Key points

- The American Heart Association has redefined patients who are at greatest risk for postsurgical infections, limiting the 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.[58-60] However, patients at higher risk for surgical site infection (SSI), endocarditis, or contamination of prosthetic joints deserve special consideration when the surgical site is infected or when mucosal sites are involved.[59,61,62] High-quality guidelines based on dermatologic surgery are lacking, and have mostly been adapted from the dental literature.

Table II. Conditions that require versus those that no longer require preprocedure 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	

The American Heart Association redefined cardiac patients at high risk for infection from dental procedures in their latest guidelines (Table II), eliminating about 90% of patients for whom antibiotic prophylaxis had previously been recommended.[61] In addition, updated guidelines do not recommend prophylaxis for indwelling devices such as cardiac pacemakers and internal defibrillators.[63] Pathogen-directed prophylaxis guidelines are summarized in Table III.[59] The American Academy of Orthopedic Surgeons with the American Dental Association published guidelines for dental patients with total joint replacement,[62] which have been extrapolated to dermatologic procedures. Recent updates recommend discontinuation of routine prophylactic antibiotics for patients with hip and knee prosthetic joint implants who are undergoing dental procedures.[64,65] 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 noninfected and nonmucosal site.

Table III. Antibiotic prophylaxis regimens and their indications

Indication	Main pathogen(s) of concern	Antibiotic(s)	Dosage(s)
Prophylaxis for infective endocarditis	Staphylococci and streptococci	Amoxicillin	2 g PO adults and 50 mg/kg PO children
Prophylaxis for contaminated surgical site	*Staphylococcus aureus* and β-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 *Staphylococcus epidermidis* or MRSA	*S epidermidis* and 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	*S aureus* and *S epidermidis*	Amoxicillin	2 g PO adults and 50 mg/kg PO children
Prophylaxis for patients who are allergic to penicillin	Staphylococcus and 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 and 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 and 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

IM, Intramuscular; *IV*, intravenous; *MRSA*, methicillin-resistant *Staphylococcus aureus*; *PO*, per os.

Recent studies have refuted the notion that certain repairs (e.g., grafts) and sites (e.g., below the knee) have higher SSI rates.[66,67] 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 recommends dosing within 120 minutes preprocedure to prevent SSIs; prolonged prophylactic antibiotics after surgery are not recommended.[67] Indiscriminate antibiotic use should be discouraged because it increases the risk of adverse events including drug reactions and antimicrobial resistance.[65,66]

SURGICAL SITE PREPARATION

Key points

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

Commonly used preoperative skin antiseptic preparations include isopropyl alcohol, povidone-iodine (PI), and CHG. Qualities to consider when choosing an antiseptic include onset and duration of action, spectrum of coverage, efficacy, and toxicity.[68,69] The method of skin application has not demonstrated any impact on preventing SSIs.[70]

Alcohol is fast-acting and effective against Gram-positive and -negative bacteria, fungi, and viruses but ineffective against spores.[71] Its disadvantages

include short duration of effect and flammability when in range of a heat-producing device, posing a risk during electrosurgery.[72,73] Combining alcohol with iodophors or CHG increases efficacy and duration of action compared with antisepsis with alcohol only.[74,75]

The damaging effect of iodine on protein and DNA gives it its antimicrobial properties.[69,76] PI is effective against Gram-positive and -negative bacteria, yeast, some bacterial spores, protozoa, and viruses including HIV and hepatitis B virus.[72,76,77] Limitations include the risk for contact dermatitis in iodine-sensitive patients, inactivation by organic material such as body fluids, and potential for systemic toxicity.[72]

CHG has broad efficacy against Gram-positive and -negative bacteria, many viruses, and fungi.[71] Contamination with organic products does not inactivate it. It is known to be ototoxic and oculotoxic, and PI can be a safe alternative.[71,78] However, a multicenter study suggested that CHGs can safely be used on facial sites not involving eyes and ears assuming careful application.[79] Notably, the US Food and Drug Administration 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.[80] Manifestations may begin with hives, facial swelling, or difficulty breathing, and can progress to anaphylactic shock.

Parachlorometaxylenol, also known as chloroxylenol, is a CHG alternative that can be safely used on periocular and periotic sites, with similar but less efficacious antimicrobial activity compared with CHG.[81] Parachlorometaxylenol is known to have poor pseudomonal coverage but is frequently formulated with additive ethylenediaminetetraacetic acid 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,[82-85] a recent meta-analysis found that antisepsis with CHG is associated with greater reduction in SSI incidence compared with iodophor compounds.[86] A survey of MMS surgeons found that CHG is their most commonly used skin antiseptic except during periocular procedures, when PI is more often used.[87]

ANESTHETICS

Key points

- LAs 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.[88] 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 7 mg/kg (or 500 mg total).[89]

Systemic toxicity of lidocaine with epinephrine includes effects on the central nervous system, cardiovascular system, and skin.[90] Central nervous system 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.[89] 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 IV. Of note, patients may also metabolize LAs at a higher rate or may experience reduced efficacy.[91]

PREVENTING WRONG-SITE PROCEDURES

Key points

- Wrong-site procedures (WSPs) are a leading cause of serious errors in dermatologic surgery
- Specific protocols should be implemented to prevent WSPs

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.[92,93]

Several issues may complicate adequate site identification, including biopsy sites on anatomic areas that are difficult to visualize, sites with previous procedures or extensive field damage, time lag between obtaining a biopsy specimen 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.[94-97] Rossy and Lawrence[98] found that the most significant factor associated with patients' inability to identify their biopsy site was lack of site visibility.[99] One prospective study found that patients who had multiple biopsy specimens

Table IV. Potential adverse events of lidocaine and epinephrine

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

obtained in 1 visit and a >6-week time lapse between the biopsy procedure and surgery had an increased risk of site misidentification.[99] 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.[95,100,101] Having a biopsy site photograph is associated with a significant reduction in postponed surgeries and increased patient confidence in site identification.[99] Although 89% of 325 MMS surgeons surveyed considered high-quality photography most useful in aiding site identification, ≤25% of their referring physicians provided them.[96] This statistic should alert referring physicians to the importance of photography before obtaining a biopsy specimen 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, Health Insurance Portability and Accountability Act–compliant transmission method to send color photographs. Newer electronic medical record software, such as EMA (Modernizing Medicine), can facilitate seamless integration of photography into the workflow.[102] 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 the right scaphoid fossa rather than the right ear).[96] Creating a workflow 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 procedure and surgery scheduling, Nijhawan et al[95] had office staff, when scheduling patient appointments for MMS consultation, ask that patients take "selfie," or self-acquired, photographs of their unhealed biopsy site and e-mail them before the appointment or bring them to their consultation. Providers can also suggest that patients take such photographs on their personal phones at the time of the biopsy procedure. More recently, others have suggested FaceTime video-chat to confirm anatomic site with the referring provider, which is compliant with the Health Insurance Portability and Accountability Act if both parties are using WPA2 Enterprise Wi-Fi.[97]

Starling and Coldiron[103] implemented a protocol involving rebiopsy if a surgical site was in question, which yielded no WSPs in 7983 MMS cases over 6 years.[103] Dermatologic surgeons and referring providers can implement such methods to minimize WSP and optimize patient safety.

CONCLUSION

Presurgical patient evaluation is critical to the success of cutaneous surgery. By managing the risks involved in patient selection, care of special populations, antithrombotic use, SSI, 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.

Conflicts of interest

None disclosed.

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