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Preventing and Managing Complications in Dermatologic Surgery: Procedural and Post-surgical Concerns

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Abstract

In the second part of this CME article, we review the evidence regarding the intraoperative and postoperative risks for patients and healthcare workers. We aim to share the most up-to-date recommendations for risk management and postoperative complication management to ensure optimal surgical efficacy and patient safety.

Keywords

dermatologic surgery; electrosurgery; wound care; pain management; wound dehiscence; hematoma; post-surgical infection

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For patients with a pacemaker or implantable cardioverter-defibrillator (ICD), there is a question regarding whether the electrosurgical current may cause electromagnetic interference (EMI) that can affect cardiac device function.[1,2] While shielding technology helps insulate cardiac devices from external electromagnetic currents, understanding how to mitigate patient risk can help prevent complications such as inhibition of the pulse-generator, pacemaker reprogramming, battery depletion, profound bradycardia or asystole, defibrillator deactivation, or direct myocardial stimulation causing arrhythmia or tissue injury.[1,3–5]

Conflicts of Interest: None declared

In dermatologic surgery, the overall risk of complications to ICDs is low with few reported events.[5,6] Theoretically patients with cardiac devices should undergo preoperative cardiology consultation to confirm the device type and patients' dependence on its function, as well as post-operative device interrogation.[1,7] However, likely due to the very low rates of reported complications, in practice few dermatologists follow through with these recommendations.[8]

General precautions in patients with a pacemaker or ICD include (1) using bipolar forceps or electrocautery and avoiding unipolar cautery when possible, (2) using short energy bursts <5 seconds in duration; (3) maintaining low power settings, (4) avoiding use within 15 centimeters of ICD/pacemakers due to risk of direct device damage, (5) avoiding cutting current, and (6) directing the current pathway away from the device with assistance of a grounding plate.[1,3,5,7,9,10] If a non-low-risk device modality is used, resuscitation support in the form of trained personal, equipment, and medications should be available.[1] There is controversy regarding whether magnet application should be used to program pacemaker devices to a fixed-rate mode, especially in patients having procedures above the umbilicus.[11,12] For patients with an ICD, magnets should not be used without clearance from cardiology or the device manufacturer, due to the risk of reprogramming and deactivation.[7]

For non-cardiac electrical implantable devices such as cochlear implants, the recommendation is to use only bipolar electrodes no closer to the implant than 1cm to avoid electrode heating, electrical shock, and device dysfunction.[7] Data on deep brain stimulators in dermatologic surgery is more limited, but bipolar forceps or a monopolar device with appropriate dispersive electrode placement is recommended.[4,7]

Other electrosurgical risks include fire and smoke inhalation by the physician, other health care providers, and the patient. Flammable materials such as towels or drapes, gauze, isopropyl alcohol, aluminum chloride, hairspray, and diethyl ether should not be in close proximity; particularly when using monopolar devices, which are the most common source of fires in Mohs micrographic surgery (MMS).[13]

Smoke plume from electrosurgery can predispose to carcinogenic, infectious, and pulmonary risks to dermatologists and team members. Specifically, smoke plume may contain high concentrations of viruses including HIV/HPV in infected patients, carcinogens including chemical acrylonitrile and benzene with mutagenic potential, and dead and live cellular materials.[14–16] One large survey study found that only 10% of dermatologic surgeons utilize smoke management practices.[16,17] The lack of awareness of surgical smoke risk and the low practice of preventative measures has also been shown in trainees.[18] Air contaminants from the surgical plume can be controlled with smoke evacuation equipment, positioning the nozzle within 1 centimeter of the surgical site, and with the use of high-filtration surgical masks such as a laser mask, N-95 mask, or a respirator approved by the National Institute for Occupational Safety and Health.[14,18,19]

The ideal wound dressing helps to achieve hemostasis, protect against infection and foreign material, limit tissue movement, provide a moist environment, lessen mechanical trauma,

and remove exudate.[20] Conventional wound dressings consist of layered components using ointment as well as non-adherent, absorbent, contouring, or compressive material.[20] Topical petrolatum has typically been preferred. Topical antibiotics have no benefit in infection prophylaxis for clean excision wounds. They can cause antimicrobial resistance and contact allergy; and studies have shown their overuse in routine excisions.[21–23] There is evidence suggesting that topical silicone may be more efficacious than petrolatum as a post-operative ointment. In contrast to petrolatum, silicone gel is non-occlusive, waterproof, gas permeable, and has antimicrobial properties.[24] Additionally, it has been shown to reduce inflammation and scar formation.[24] Beyond hydration and healing, ointments also prevent adhesion of the dressing to the wound, facilitating removal.[20]

Post-operative acute secondary intention wounds may benefit from occlusive or semi-occlusive wound dressings for optimal healing, as they prevent desiccation and infection, and can be associated with faster healing times.[20,24,25] Children may especially benefit from wound re-enforcement with short adhesive strips over sutures, stretch bandage wraps, or balaklava-like head dressings.[26] For special site considerations, liquid bandages have demonstrated safety and efficacy for sutured facial excisions, bone wax has demonstrated success in the concha, and zinc oxide compression dressings can be used for leg excisions.[27–29]

As MMS often results in large defects, use of skin substitutes can offer an alternative to large flaps or autografts, and/or secondary intention healing for the right wound in the right patient.[30] The goal of skin substitutes in the acute post-operative period is to provide matrix, cells, and other healing materials as a scaffold for host tissue integration and revascularization; they are generally biodegradable. Skin substitutes can be epidermal, dermal (cellular or acellular), or composite (epidermal and dermal) as well as synthetic or biologic.[20] These dressings offer advantages over conventional autografts in avoiding donor site creation, reducing autologous skin graft thickness, decreasing pain, reducing number of required dressing changes, covering the surface of a large defect, and decreasing healing times.

Epidermal autografts are not frequently used for postoperative wounds as they are friable, associated with high infection risk and poor graft uptake, and take many weeks to cultivate.[20] Dermal grafts applied directly to the wound can stimulate healing. Bovine and porcine acellular dermal xenografts can be useful for deep wounds with exposed bone, tendon, or cartilage providing an opportunity for soft tissue bulk/dermal regeneration prior to repair.[30] Cellular dermal allografts stimulate extracellular matrix to produce wound healing proteins, but can stimulate a robust immunogenic host response.[31] A cellular dermal allograft known as Dermagraft™ has been used successfully for intra-oral defects.[32] Composite grafts have been engineered as skin equivalents. Apligraf™ is one such graft that provides analgesia, ease of wound care, and good outcomes in the acute post-operative setting. Compared to secondary intention healing, Apligraf has been associated with improved cosmesis and less vascular scars in full thickness MMS defects.[33]

Wound dehiscence is estimated to occur in 8% of dermatologic surgery cases.[34,35] Risk factors for dehiscence include increased age, anatomic sites under increased tension,

infection, hematoma formation, smoking, and use of vascular endothelial growth factor inhibitors (VEGF) or oral tyrosine kinase inhibitors.[34,36–41]. Choice of closure modality (sutures versus adhesives versus staples) does not significantly impact dehiscence risk.[42,43]

Although dehiscence can occur at any time, it most commonly occurs approximately two weeks post-procedure, when scar tensile strength is at 10% of normal. If the wound is clean and without signs of infection or hematoma, the surgeon should consider re-suturing. While cutaneous surgical literature on this topic is limited, surgical debridement and primary closure were shown to significantly decrease healing time compared to secondary intention healing for dehisced sternotomy wounds (12.2 vs. 29.7 days).[44] There is no clear consensus on whether wounds should be freshened with excision or debridement prior to re-suturing due to concern that this may remove active fibroblasts and decrease tensile strength, as opposed to applying new sutures directly to dehisced wound edges. [34,45,46] There is also no clear consensus regarding length of time after dehiscence that resuturing is a viable option. A study by Justiano and Eisen noted acceptable outcomes in a group of patients whose wounds were resutured at an average time of approximately five days after dehiscence.[46] Resuturing after three to five days post-dehiscence is often less successful in the authors' experience. Friable tissue often cannot hold deep buried sutures. In such cases the wound can be closed with simple sutures.[46] Placement of Steri-Strips is an alternative to sutures in dehisced wounds for patients who wish to avoid needles, although patients should be counseled that healing times may be slower, the scar may be wider, and there may be premature release of the Steri-Strips.[45,47] Dehiscence due to infection or hematoma should be appropriately treated prior to consideration of repeat closure.

Post-operative hematoma formation is rare, reported in 0.1–2.4% of dermatologic surgical cases. Flap and graft reconstruction are at higher risk.[48–52] In the plastic surgery literature, hypertension is considered a risk factor, with studies showing reduced risk with good intraoperative and post-operative blood pressure control.[53,54] It may therefore be worth obtaining a blood pressure reading postoperatively in patients with hypertension requiring more significant reconstructions.[55] Large scale studies from other specialties have identified risk factors including male sex, preoperative bleeding diathesis, multiple procedures, preoperative anticoagulant use, preoperative anemia, low body-mass-index (BMI), and four or more comorbidities.[56–58] Significant hematomas can be prevented with meticulous hemostasis, pressure dressings, and closing dead space,.[59]

To avoid infection, depending on size, hematomas can be treated with aspiration with a large bore (16-18 gauge) needle within 48 hours of formation versus opening the surgical wound with evacuation and irrigation if after 48 hours of formation.[50,60] A hematoma enters liquefactive stage after 7 to 10 days. At this point, it is appropriate to treat with needle aspiration.[61]After evacuation, if residual bleeding is controlled and the surgical site is dry, the wound may be repaired with attention to closing dead space. Many providers will start antibiotics empirically to prevent infection. For an actively expanding hematoma, the wound should be partially or fully opened to allow for ligation or cautery of the culprit vessel.[62] In such cases, providers have anecdotally suggested numbing with lidocaine without epinephrine during wound opening and evacuation for ease in finding the bleeding source. In cases of recurrent capillary ooze for patients on antithrombotics, use of fibrin

sealants containing fibrinogen and thrombin may be helpful and are commonly used by plastic surgeons to prevent hematoma formation after facelift.[63,64]

Dermatologic surgery has an extremely low infection risk, estimated between 0.4-2.5%.[65] The most common timeframe for SSIs is between 4-10 days post-operatively. The formal definition for SSI by the Centers for Disease Control and Prevention (CDC) is an infection only involving skin and subcutaneous tissue occurring within 30 days post-operatively.[66] At least one of the following is also required for diagnosis: (1) purulent drainage from the incision site; (2) organism isolation from a culture of incisional fluid or tissue; (3) tenderness or localized swelling with warmth and erythema; or (4) a clinical diagnosis of SSI by the physician.[66] SSI is considered a national performance measure for MMS safety.[67]

Endogenous host risk factors in dermatologic surgery include diabetes, smoking, BMI greater than 25 kg/m^2, anatomic site, preoperative contamination, anticoagulation therapy, preoperative hypoalbuminemia, nasal Staphylococcus aureus carriage, and age (risk steadily increases with age).[68–74] Immunosuppression does not appear to be a significant risk factor.[75] Other SSI risk factors reported in the literature include lack of sterile draping, operation duration longer than approximately 24 minutes, type of reconstruction with flaps and grafts, excision size over 2 centimeters, hemostasis issues, and healing by secondary intention.[70,76–79] Stringent surgical attire or use of electrocautery over scalpel have not been shown to decrease SSI risk.[80–84]

Brewer et al published a large meta-analysis examining 11,071 patients who underwent outpatient surgical procedures including laceration repair, MMS, simple excisions, and tooth extractions.[85] There was no significant difference in likelihood of developing SSI when providers used sterile versus non-sterile gloves.[85] Topical antibiotics are not generally recommended for clean excision wounds as their use has not been shown to decrease SSI incidence but is associated with contact dermatitis.[21–23] However, providers should consider topical antibiotics for wounds left to heal by secondary intention, as one large Cochrane review did demonstrate relative SSI risk reduction with topical antibiotics (RR 0.61, 95% CI 0.42-0.87).[86] There may be other circumstances in which providers may want to prescribe topical antibiotics, such as poor personal hygiene or for specific sites such as lower legs in diabetic patients or close proximity to the nasal mucosa, but there is currently lack of published studies to support routine use in these cases. Early dressing removal with normal bathing 12 hours post-surgery versus delayed dressing change with regular bathing after 48 hours does not affect SSI risk .[87,88]

Routine postoperative oral antimicrobial use has not shown robust benefit in SSI prevention and is not recommended.[22,65,89] Although staphylococcus aureus colonization has been associated with risk for SSI, routine presurgical swabbing would be impractical, unnecessarily burdensome, and costly. For patients known to be colonized with S. aureus, pre-surgical topical decolonization with intranasal mupirocin and chlorhexidine gluconate body wash are associated with decreased SSI incidence, opposed to perioperative oral antibiotic use.[90]

If SSI occurs, wound cultures can be obtained. However, empirical antibiotic coverage against *S. aureus* and *Streptococcus pyogenes* with cephalosporins is often first-line treatment, unless patients are at high risk for methicillin-resistant *S. aureus* (MRSA) in which case first line options include doxcycyline, clindamycin, or trimethoprim-sulfamethoxazole.[91]

Most patients experience little post-operative pain after MMS and standard excisions. The day of surgery is associated with the greatest post-operative pain. One study found that pain after MMS dropped significantly by post-operative day four, which should guide prescription habits. Increased post-operative pain is associated with pre-operative anxiety, multiple lesions treated at once, surgical sites involving the lip, forehead, scalp, genitalia, nail, chest, leg and nose, and flaps or grafts.[92–94] Secondary intention healing is associated with less post-operative pain.[94] Nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen as monotherapy or in combination are recommended as first-line post-operative analgesia.

NSAID risks include gastric mucosal erosion, renal impairment, and cardiovascular events even with short-term use in high risk patients.[95] Aspirin specifically increases bleeding time.[95] Thus, the risk-benefit ratio should be evaluated carefully, particularly for large excisions, flaps and grafts where sufficient evidence for NSAID use is limited.[95] NSAIDs are not recommended in cirrhotic patients due to increased gastrointestinal bleeding and renal dysfunction.[96] Acetaminophen is widely used for analgesia after minor procedures and is particularly useful for patients with NSAID allergy, peptic ulcers, renal impairment, and aspirin intolerance.[97,98] Lower dosages are recommended for patients with liver disease, anorexia, or alcohol intake of more than three drinks daily.[98]

There is a limit to therapeutic efficacy for both NSAIDS and acetaminophen.[95] Short-term opioids and tramadol can be considered second line options for moderate to severe pain. There is no clear evidence to determine the scenarios in which opioids rather than non-opioid pain medications should be considered postoperatively. Opioids act directly on the μ receptors in the central nervous system to produce analgesic effects, which vary highly between patients.[95,98] Adverse effects include nausea, constipation, and respiratory depression, as well as chronic dependence and addiction.[95,99,100] If prescribing opioids, providers may concomitantly want to suggest use of a stool softener to avoid constipation.

Persistent opioid use after minor non-dermatologic surgery is commonly reported, with pre-operative pain or behavioral disorders being strongly associated.[101] Opioids are not often used in the dermatology surgery setting. Those who do use them may take very few pills and are then left with remaining pills.[94,102] Opioids should be ordered at the lowest strength and shortest duration possible; the quantity prescribed should be controlled to prevent dependence or prevent use of remaining pills by others.[93,103] In a prospective study of patients undergoing cutaneous procedures, the majority did not require opioids and of those who did, 36 hours of treatment was sufficient.[104]

Gabapentin increases gamma-aminobutyric acid to modulate pain. Its supplementary use can reduce opioid requirements.[105] Common adverse effects include dizziness and sedation.[98]

Tramadol has multiple mechanisms of analgesia, some of which act through the opioid receptor. Advantages over opioids include decreased respiratory depression, decreased gastrointestinal effects, and decreased central nervous system driven dependence and addiction.[100]

In one Cochrane review, addition of codeine to acetaminophen only increased the proportion of patients with at least 50% pain relief from 10 to 15%.[106] Additionally, use of tramadol monotherapy post-operatively showed 97% control rates through post-operative day 4 after MMS.[107] In one double-blind randomized controlled trial, patients immediately post-MMS were given acetaminophen alone, acetaminophen with ibuprofen, or acetaminophen and codeine, with 1000 mg acetaminophen combined with 400 mg ibuprofen every 4 hours providing the most efficacious postoperative pain control.[97] In totality, studies recommend minimizing opioids for pain relief in dermatologic surgery. Dual therapy with acetaminophen and ibuprofen should be considered first-line for patients at risk for increased pain, with monotherapy appropriate for routine procedures.

Conclusion

The intraoperative setting poses risks that are important to recognize and mitigate appropriately. Proper postoperative wound dressings, pain management, and patient counseling regarding wound care can help prevent wound dehiscence, surgical site infection, poor pain control, and opioid dependence. The dermatologic surgeon must be able to manage the post-operative complications of dehiscence and hematoma formation. Such complications can be prevented or managed effectively to promote a good surgical outcome.

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Electrosurgery Risks

Key points:

- Although electrosurgery risk in patients with cardiac implantable devices is low, the risk can be mitigated by using bipolar forceps or electrocautery.
- Surgeons should use bipolar electrodes no closer to the device than 1cm for non-cardiac implantable devices.
- Risks to the surgeon should be managed with surgical masks and smoke evacuation.

Post-Surgical Wound Care

Key points:

- Newer evidence suggests that topical silicone gel may have greater efficacy than petrolatum.
- Biologic dressings may have advantages over conventional autografts in properly selected patients.

Wound Dehiscence

Key points:

- Increased tension, infection, hematoma, smoking, and increased age all increase risk of wound dehiscence.
- Clean, dehisced wounds can be managed with re-suturing.

Hematoma Management

Key points:

- Hematomas are rare dermatologic surgical complications.
- Treatment can include aspiration with a large bore needle or opening the wound for evacuation and possible vascular ligation if an expanding hematoma is present.

Surgical Site Infections

Key points:

- Surgical site infections (SSI) are exceedingly rare.
- Postoperative antibiotic prophylaxis is not routinely recommended.

Post-Operative Pain Management

Key points:

- Nonsteroidal anti-inflammatory drugs and acetaminophen should be used for first-line post-operative analgesia.
- Short-term opioid medication strength and treatment duration should be limited and carefully monitored to prevent dependency.