Audio Companion for SESAP® 16
SKIN/SOFT TISSUE — Category 12

Contributors:

**John A Weigelt, MD, FACS**
Professor of Surgery and
Chief of the Division of Trauma and Critical Care
Medical College of Wisconsin
Madison, WI

**Nicole Gibran, MD, FACS**
Professor
Director University of Washington Medicine Regional Burn Center
University of Washington Department of Surgery
Seattle, WA

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*The following faculty report no relevant financial interests:* Dr Nicole Gibran.
Diagnostic Tools for Soft Tissue Infections

Most clinicians who take care of necrotizing soft tissue infections acutely and tertiary centers that care for these patients would say the number 1 diagnostic tool is a visual exam of the wound. No laboratory values can replace that crucial clinical assessment. However, many clinicians — whether they are emergency doctors or community surgeons — do not have the expertise to differentiate a small abscess or a non-complicated abscess from necrotizing fasciitis. In that case, some of the screening tools — such as the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) tool which evaluates CRP, white count, hemoglobin, sodium, creatinine and glucose — become useful.

Problems: The problem is there are other reports in the literature that suggest the parameters associated with worse outcome after a soft tissue infection might be a little different than the LRINEC criteria. For instance, Eileen Bulger (first author, Anaya) published a paper in 2009 that suggested that age >50, heart rate >110, hypothermia, white count >40, creatinine level >1.5, and hemoconcentration with a hematocrit >50 has a poor prognosis with necrotizing soft tissue infection. There are some subtle differences in some of these assessment tools. Being able to look at the wound and seeing whether or not they are hemorrhagic bullae or whether or not there is crepitus on physical exam is very useful.

Physical Findings: If a patient has hemorrhagic bullae, you should be very suspicious of soft tissue infection. Additionally, if it is very boggy, ruddy, firm, inflamed wound, then your suspicion should be high. Also, many of these are on the extremities, and if you have any evidence of pain on dorsiflexion or plantar flexion of your ankles, that would suggest your fasciae are inflamed or irritated. A good physical exam is probably the best way to diagnose soft tissue infection, and everything else would be supernumerary.

Incise Patient With Necrotizing Infection

If you had a suspicion of a necrotizing infection in a patient that has a very painful, swollen extremity, I think it would be appropriate to make an incision. You may not need to do an extirpation of all of the soft tissue overlying the fascia, but making a small incision into the skin and seeing whether or not there is evidence of soft tissue necrosis or soft tissue liquefaction would be appropriate.

Gangrene: Classically, Fournier’s gangrene was a description of a necrotizing soft tissue infection associated with diabetes in the perineum, but clinically it is not necessarily different than other types of necrotizing soft tissue infections. The only caveat I would say is the fact the patient may have some underlying diabetes or other comorbidities might make him or her more susceptible to sepsis. If you were going to categorize necrotizing soft tissue infections, maybe the most dangerous ones are the ones we see due to clostridia. They can deteriorate very quickly.

Caveats to Recognizing Group A Streptococcal Gangrene

We emphasize with our residents that if patients with group A streptococcal (GAS) gangrene go to the Operating Room and you think you have fully treated them, you need to re-evaluate within 6 to 12 hours, as they may need to go back to the Operating Room. Until you are sure the process has stopped, these patients are best served to be scheduled back into the Operating Room as an anticipated re-evaluation and re-assessment.

Surgical Principles: When you take them to the Operating Room, there is a growing tendency to try to preserve skin flaps. When general surgeons are collaborating with plastic surgeons, they are trying to debride all of the dead tissue overlying the fascia and at the fascia level. Since the overlying skin often is or sometimes is preserved and not involved, it is possible in some situations now to explore the wound subcutaneously but leave the skin intact. This is 1 evolving approach that makes reconstruction after
Different Epidermal Sloughing Conditions Present Differently

Epidermal sloughing conditions such as toxic epidermal necrolysis (TEN), Stevens-Johnson, or scalded skin are often very tricky to differentiate, but there are some subtle differences in the way these patients present. A classic patient with scalded skin will have some sort of prodrome that will often be associated with an infection. They typically do not present with a maculopapular rash. They typically have a very, very intense cherry-red appearance to their skin and to the underlying sloughed dermal wound bed in contrast to a TEN patient who will have a very discrete maculopapular rash that extends and eventually becomes confluent. If it is just the rash, it might be considered to be Stevens-Johnson syndrome or if it extends and involves more than 10% to 15% of the total body surface area, then it is on the same spectrum, but it might be considered to be toxic epidermolysis necrosis. One of the classic hallmarks of TEN is that there is mucosal involvement in the perianal area and the oral mucosa and the eyes. If the patients do not have some sort of mucosal involvement in their mouths, we have to consider that it is not on the TEN spectrum.

Treatment: The treatment for those is supportive. There is no treatment to prevent progression of TEN, per se. In the late 1990s, there was a landmark paper in science that suggested that IVIG would change the course, but over time most of the dermatologists and burn surgeons who cared for TEN realized that it really had no effect on outcomes and actually had some inherent risks, so most clinicians have abandoned its use. In patients who have TEN, treatment with systemic steroids has been generally associated with worse outcomes, so we do not recommend corticosteroids systemically for this syndrome. It is hard to know whether or not the patients who developed TEN are actually a subset resistant to corticosteroids. My suspicion is we are only seeing the tip of the iceberg and the outpatient dermatology community treats a considerable population of patients with what looks like early TEN or Stevens-Johnson with corticosteroids. It is hard to know whether or not corticosteroids are contraindicated in all patients with maculopapular rash. When a surgeon sees TEN, it is classically at the basement membranes, so it is a slough of the basal cells of the epidermis. That is why there should not need to be any skin grafting. The treatment of choice would be some sort of dermal protection so that patients can epithelialize wounds on their own. There should not be any type of skin grafting required.

Treatment of Patients With Sloughing Conditions

TEN: TEN patients are at risk because they have denoted a large portion of their skin. Although they are at risk for infection, we would not advocate prophylactic antibiotics. We would just recommend expeditious treatment of an infection if it develops. This would be considered the principle of antibiotics stewardship we are increasingly acknowledging in the medical community.

Infections: For a true necrotizing soft tissue infection, treatment should be adjunctive. There is some debate about the appropriate regimen of antibiotics. At our facility where we have a high incidence of both streptococcal-caused soft tissue infections and clostridia, we have a high incidence of methicillin-resistant staph. Our de facto regimen would be clindamycin, gentamicin, vancomycin, and Penicillin G. I think 1 important note is that for patients you suspect of having NSTI, clindamycin is an important element in the regimen just because it is a protein synthesis inhibitor and it will inhibit toxin production. So, the combination of a protein synthesis inhibitor and a cell wall antibiotic is still a basic principle in treating these patients.
Hyperbaric Oxygen: There is a very narrow utilization, or indication, in which hyperbaric oxygen is beneficial. There is some suggestion that for clostridial and anaerobic infections, it can be beneficial. The problem with many of these patients who have necrotizing soft tissue infections is that they are in septic shock, and the hyperbaric oxygen chamber is not a safe venue for them. The best place for them, actually, is probably in the Intensive Care Unit where they can have active resuscitation. So, unless it is a small isolated wound and the patient is generally hemodynamically stable, I do not think that hyperbaric oxygen is a good option for them.

Screen Patients at High Risk for MRSA

Patients with skin infections are at huge risk of methicillin-resistant staph aureus (MRSA) when they have long hospitalizations. Typically, we suspect an MRSA infection in our patients when they have pus-filled blisters surrounding a wound. There is a very characteristic nesting appearance of multiple little blisters that appear to have a creamy yellow drainage in them. They will be associated with some cellulitis, and they tend to be reddened and inflamed. For our patients who have been in the hospital a long time, MRSA tends to occur in both injured skin and in non-injured skin. We will often see infection in our healed donor sites or in our healed partial thickness wounds. The other area that we often will see is furuncles in uninjured skin, which certainly raise our suspicion of a MRSA infection. The groups I inherently worry about and that raise my suspicion are patients who have been cohorted. Patients who have come from jail or a nursing home or who are homeless or have a history of drug use are at higher risk of MRSA. It should be anticipated in these patients, and they should be screened on admission. In fact, we screen all of our patients who are admitted to both our Burn Center and our Intensive Care Unit using PCR, nasal, umbilical, or rectal swabs.

Avoiding Multiple Recurrences of MRSA in Donor Sites

Case: You have a patient in whom everything is going right, but he continually comes back with a MRSA infection in his donor sites. You have treated him a couple of times.

Recommendations: We actually do something that is a little low tech. We do not try to eradicate the infection with mupirocin, but, in our hospital, we have implemented a new policy for any of our patients who are undergoing anesthesia. We are swabbing their nares with Betadine® paint, and there are some studies that demonstrate that this is just as effective and less associated with resistance than topical mupirocin in the nares. When my outpatients come back with repeated pustules in their healed wounds, I actually recommend, when it is possible, they fill their tub with warm water and add 1 cup of bleach. They soak in the tub for 15 minutes, and then take a shower. This is a trick I learned from a dermatology colleague years ago, and it seems to work. I suppose it is no different than Dakin’s solution.

Monitoring Metabolic Response

Our ability to monitor the metabolic response is still not very good. We are left with serial measurements of C-reactive protein — which is neither very specific nor is it very sensitive — and transferrin — which, again, is not very sensitive or specific. You do see trends. It is interesting to me that if I do a major grafting procedure and create huge new donor sites in a patient, if there happens to be a CRP and transferrin, or pre-albumin, drawn the next day, I will see the CRP bump up and the pre-albumin drop. But it is certainly not specific.

Children: A lot of people have recommended using metabolic carts or indirect calorimetry for burn patients, but especially in children, there are reports those are unreliable. And for many of us, a problem with that
approach is that, if our patients are not intubated, the metabolic carts are less reliable than if the patient actually is intubated. So, we do not have tremendous ability to monitor our patient’s metabolic status. Having said that, I think the work that David Herndon has led predominately using oxandrolone and also propranolol in children is very promising.

**Adults:** Most of the burn community, without tremendous evidence, has de facto adopted that approach for adults as well. There is very little evidence that it works, but there is currently an ongoing multicenter trial looking at the ability of propranolol to modulate metabolism in burn patients. The doses that Dr. Herndon reports of 1 mg/kg in children is really not achievable in adults; we actually published a paper a few years ago showing we were never able to reach that goal, and we had tremendous numbers of dose holds because of hypotension. I think the jury is still out as to whether or not it is efficacious and safe in adults. Oxandrolone actually is much safer. It does not have the downside risk factors unless you have a patient with hepatic disease, and you want to avoid it in a patient with prostate disease. The target for knowing that your propranolol is effective is a decrease in heart rate by 15% to 20%. But if you have heart rates in the low 100s or 90s, at that point, you can probably stop the propranolol. With his child patients, Dr. Herndon continues it for a year after injury. So, even in the outpatient arena, his patients continue to be treated with propranolol with the idea that growth arrest is very significant in those patients. That has been his hypothesis for why it is necessary for sustained continuation of propranolol and oxandrolone for as much as a year after injury.

**Dietician Plays Role in Response to Burn Injury**

It is important a surgical team, which traditionally has been multidisciplinary, has a good relationship with a dietician who can calculate the needs of the patients. Obviously, patients with major burns who are intubated should receive continuous tube feeds. This is beneficial not just for their anabolic needs but also to prevent stress ulcers, which is a traditional life-threatening complication we rarely see any more since we started tube feeds in these patients. I do not think there is a magic formula. There is an ongoing multi-center study right now to determine whether glutamine has a benefit. There are certainly advocates of glutamine supplementation. From my standpoint, I think that one of the hot topics in burn nutrition now is the role of micronutrients: Zinc, selenium, vitamin E, vitamin D, and vitamin C — all of which enhance wound healing and enhance responses to injury.

**Nitrogen Balance:** It is not really feasible in a patient with a big burn to depend on nitrogen balance studies because the urinary nitrogen loss we traditionally measured is just a small part of what these patients are losing. The amount of nitrogen exuded from the wounds is really not measurable. If you just depended on urinary nitrogen levels, you would significantly underestimate your needs. We did this for years, but we have largely abandoned the 24-hour nitrogen levels. One of the issues we have identified, not only in burn patients but other patients who have acute surgical need, is the fact that they go back to the Operating Room so many times and their tube feeds are often held. One of the principles to maximize nutritional support in these patients is the realization it is safe to continue tube feeds in the Operating Room for patients who are intubated. This practice has decreased problems we have with patients who do not get adequate calories because their tube feeds are always being stopped for this or that.

**Novel Approaches:** There are some other interesting approaches to feeding that I think are novel. One idea is that of volume-based tube feeds. The bedside nurse is given the parameters as to what a patient needs over a 24-hour period. The nurses have the ability to increase or decrease the amount, depending on whether they are doing wound care or whether they are turning the patient, and fluctuate it so the patient receives their 24-hour volume although not at a fixed hourly rate. I think this is a creative addition to tube feeding and nutrition. With regards to other approaches to maintaining muscle mass, the early mobility trend we have is going to be very important for reducing the muscle wasting we see. I am enthusiastic about implementing more exercise-based routines, even at the point when patients are critically ill.
How to Treat Hypovolemic Shock

We still struggle with how to treat hypovolemic shock, and there is no agreement any more now than there was 25 years. Crystalloid resuscitation is not necessarily the favored child that it used to be. There are still advocates for albumin early on. I think many of us very much would like the excuse to use FFP as part of our resuscitative program but do not do that unless the patient’s INR is elevated. Everything is a pendulum, and colloid is regaining favor as part of the burn resuscitation modality. Again, there is a proposed multi-center trial to evaluate albumin once and for all, that has been proposed, and I do not know the status of that. I know a number of burn providers across the country have submitted a proposal to collaborate to address just that question.

Escharotomies Are Still Useful

Escharotomies are still a very important tool in the armamentarium of the burn surgeon. I do not think they should be done prophylactically. In my experience, when they are not done by someone responsible for the eventual excision of the wound, they tend to be too deep and cause a terrible long-term aesthetic result. In order avoid forever having that divot, or line, in the tissue, the definitive surgery has to involve cutting away a lot of the subcutaneous fat. In my mind, they should be performed on patients who have had a change in their level of perfusion, and that usually does not happen for 8 to 12 hours after the injury because that is when the edema has become very pronounced. This is when escharotomies are indicated, when the patient has demonstrated they have so much extravascular edema that they are compromising blood flow to their extremities. In terms of torso escharotomies, I think they can, again, be delayed until the patient shows evidence of ventilatory compromise. So, if the patient is ventilating and oxygenating well, I do not think they should be performed prophylactically. However, they are potentially beneficial in the patient who you think may be having a compartment syndrome. If you have a circumferential burn of the abdomen, an initial step before you consider a decompressive laparotomy might be abdominal escharotomies to see if that is sufficient to decrease your bladder pressures. They are definitely still tools in the armamentarium.

Wound Dressing Options Have Changed Burn Treatment

In the spirit of decreasing pain and minimizing the amount of dressing changes the patient has, a long-acting silver-based dressing is the way to go for these patients. These can stay on for 7 days. They can be removed in the clinic, and there are many different ones on the market now. The original one came that out in the 1990s was ACTICOAT, but now there are many different products that can be employed. I think it is just a personal preference by the providers as to which one is more user friendly. I also think dressing changes for superficial second-degree burns are absolutely unnecessary. These dressings have changed how burns are managed because patients that used to be admitted into the hospital for daily Silvadene® or topical antibiotic dressing changes are now seen in the Emergency Department, treated by the Burn Team, put into one of these long-acting silver dressings, and sent home, then managed in the Outpatient Clinic as much as a week later. So, this has changed how we practice burns in this country.

Use of Negative-Pressure Wound Dressing Beneficial

When negative-pressure devices first came on the scene, a number of initial studies suggested — specifically for hand burns — that a negative-pressure dressing could decrease edema in the hand and could actually decrease the need for surgical treatment. In spite of that, it has not taken hold. I think the
reason for that is there is such a strong culture of mandating that patients participate in an active range-of-motion rehabilitation or therapy program, and the negative-pressure devices interrupt that. Although there was some promise with 1 clinical trial, it has never emerged as a convenient and useful tool for the acute burn.

**Hospitalized Patient:** If a patient has a 30% to 50% flash burn that looks like it is all second degree or even if there are some indeterminate areas that you cannot tell whether it is a deep second degree or maybe a third degree, it is feasible to put patients into a massive dressing comprised of silver-based treatment and keep them in the hospital even though they do not require daily wound care because they still have considerable pain that can require doses of opioids unsafe to take at home. Even though these patients are not requiring daily wound care, they still have needs that benefit from hospitalization. The other dressing that is mostly used for chronic wounds may show some promise with some partial thickness wounds or even some deep wounds and people around the country are exploring is medical-grade honey. For chronic wounds, it is a fascinating product that sometimes produces results that nothing else has been able to produce.

**Downfalls:** One of the problems with it is that patients will lick their fingers, so if we use it for hand burns, they will be licking their fingers because the honey actually tastes pretty good. There are also products that are a hydrocolloid impregnated with the honey, which will be licking their fingers, so if we use it for hand burns, they will be licking their fingers because the honey actually tastes pretty good. There are also some products that are a hydrocolloid impregnated with the honey, and the honey will actually drip down the patient’s face, so they lick their lips all the time.

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**Whether Clinical Diagnosis Is Necessary for Inhalation Injury Still Not Definitive**

When considering inhalation injury, the question arises of whether this is a clinical diagnosis only or if an invasive or a noninvasive test is necessary to make this diagnosis. I think in 6 months to 1 year, I will be able to give you a more definitive answer. There has been a Department of Defense-funded multi-center trial that has just recently closed, but the data have not been analyzed yet. I think the real answer to this debate is going to be to hang tight. Until now, many of us believed it was a clinical diagnosis. There was a paper published in 2008 with senior author Dr Richard Gamelli. This has changed how I evaluate inhalation injury. For years, it was a clinical diagnosis, as nothing was going to change what we ultimately did. You were going to base your ongoing ventilator management on clinical responses, so if the patient had increasing needs, you would ventilate them and oxygenate them for a longer period of time. And if they were weaning and had a cuff leak, then you would extubate them. But this paper by Moser et al changed how I looked at this. When they bronchoscooped patients to grade the degree of inhalation injury, they sent a bronchoalveolar lavage sample for quantitative culture. The results were really quite shocking. These were done on admission, within 12 hours of admission, or within 24 hours of admission to the hospital. They found >50% of patients had a pathogenic organism. This made me think our patients have a potentially treatable pneumonia. One of the reasons it struck me is there was a patient population that scared me — immunocompromised patients who might be alcoholics who had a small burn, 20% burn, and they would come in intubated. They did not appear to have an inhalation injury. We would extubate them at 24 hours, and then at 72 hours they would turn up their toes and die from a fulminant pneumonia. You could almost set your clocks by it. This paper changed my view of how patients with suspected inhalation injuries should be evaluated. Now, our current practice is, if we think the patient has an inhalation injury based on carbon monoxide level, pharyngeal blistering, and/or carbonaceous sputum from the endotracheal tube, we will bronchoscope them. Grading them based on their tracheal or their bronchial mucosa is less helpful than the lavage results. We can treat them appropriately with an antibiotic if they have quantitative cultures that are over 100,000 colony-forming units.
Use of Antibiotics in Patients With Inhalation Injuries

We wait until we have an organism we can target before we start antibiotics. If in 24 hours we had an organism but do not have antibiotic susceptibility, we would empirically start treating that bacteria and then refine the antibiotics based on their susceptibility. When the diagnosis of an inhalation injury is made, resuscitation management does not change de facto. We do not make a change, but we anticipate the fact a patient with a significant inhalation injury likely has much larger inflammatory response and therefore may require more fluids. In general, if you had a patient with a small burn, under 20%, and you knew they had an inhalation injury, you would try to run them a little dryer since pulmonary edema and pleural effusions associated with an inhalation injury are going to have a much higher risk for ARDS. We know that an inhalation injury — a significant inhalation injury with significant sloughing of the mucosa and alveolar pneumonitis — may have a higher inflammatory response, and we may need to anticipate they are going to have more resuscitative needs. But we de facto would try, if they are responsive, to run them a little dryer than we would, if they clinically respond.

Obese Patients: There have been a number of studies that have looked at what the risk factors for patients with inhalation injury. Many would say inhalation injury has a worse effect in children, but that is not true. It turns out that patients who have increased BMI are more at risk of an ARDS when they have a burn and an inhalation injury. Part of this might be that resuscitation in these patients is often challenging because the whole premise of resuscitation is based on ideal weight, so the morbidly obese patient has a more difficult resuscitation than patients who have a normal BMI.

Dressing Preferences Vary

Just like partial thickness wound, the burn community has transitioned to using dressings that do not need to be changed. Again, there is no ideal dressing, and I think if you had a room of 10 burn surgeons you would have 12 different opinions about what the ideal donor-site dressing is. We have adopted the use of long-acting silver dressings for these wounds just as we have for a partial thickness wounds. Most clinicians who are not burn surgeons will not care for small children, those still in diapers. However, it is very convenient to take the skin graft from their bottoms and then just put Silvadene in the diaper. Every time they soil the diaper, you just re-apply Silvadene. And the advantage of that is that the donor site, even if there are going to be complications with scarring, is hidden. The patient can have a hidden donor site and wear a bathing suit without worrying about scars on the legs or the torso.

Three Groups at Highest Risk for Non-Accidental Injuries

Pediatric surgeons care for children who are burned as a result of what is now called non-accidental injury. There are 2 groups I worry about in addition to children. One group comprises elderly patients who are infirm, and the other group comprises disabled patients. We often see patients who are dependent on caregivers for bathing due to any type of cognitive disability. We see immersion burns in those patients. Actually, 1 of the injuries we care for in the elderly that is common is patients who smoke while on oxygen. There was an investigative report in my local newspaper several years ago about a patient who we cared for. The investigative reporter was positive that — because this patient was at a nursing facility and was outside in the courtyard when someone gave the patient a cigarette while on their oxygen — that should be considered an adult protective service issue and that was consistent with elder abuse. It had never dawned on me that was a type of elder abuse, but maybe societal views have evolved.

Immersion Burns: We do see immersion burns in the elderly, infirm, and disabled in addition to children. One of the hallmarks of that is sparing of certain parts of the body. If you were to have
someone who had a scald injury and could not get out of the bath, you might see sparing in the popliteal fossa and the inguinal crease because it is a sign that they are withdrawing. One of the questions that is very confounding and I even hear in the courtroom sometimes is how there can be sparing on the buttocks and on the soles of the feet. It turns out that, when you are in the tub, parts of your body are fixed to the bottom of the tub and protected. So, you can see these scald burns that are obviously immersion injuries but have sparing of certain parts of the body.

**Four Degrees of Frostbite**

Some people talk about a cold injury in 3-stage terminology, but some will expand it to 4 levels of severity. I prefer 4. First-degree injury has a little bit of redness, a little bit of swelling, and no blistering. A second-degree injury has some clear blisters in addition to the other descriptors. A third-degree frostbite would have some hemorrhagic blisters. A fourth-degree injury can be like a third-degree full thickness burn. It can come with different colors; it might be hard and white. It might be waxy. It might be obviously gangrenous from the beginning. It is easy to know that the tissue injury is worse in a fourth-degree frostbite, but it can also have different appearances. So, just like a third-degree burn might be dry and white or it might be dry and dark red and non-blanching or it could black or sometimes it can be green, fourth-degree frostbite injury can have different appearances and just represent tissue necrosis. **Pathophysiology:** If you are going to differentiate a true frostbite, ice forms in the tissue. There is also the pathophysiology associated with trench foot, which really is sort of a slow insidious process that never actually forms ice crystals but certainly can cause a cold injury. This tends to be a slower process than a true freeze a patient might get when they are trudging out in the snow. **Vascular Component:** There is a vasculitis that develops. And if you believe the literature about people who do angiograms, the vasculature is altered and you do get thrombosis in the distal vessels. But I have to believe it is more than just a capillary event. The small group of patients who benefit from TPA, obviously, suggests a vasculitis or a capillary thrombosis is part of the pathophysiology, but I cannot say I would agree it is only related to the vascular component of the tissue injury.

**What Patients Need Systemic Resuscitation?**

Unless it is very extensive, I think that the typical patient we see does not have hypothermia with a systemic cold injury. Most of the patients have localized injury either to their feet or their hands. Certainly, if you have a patient with systemic cold injury and they actually have hypothermia, you need to address the hypothermia with re-warming. But if you are talking about a localized frostbite to the feet or fingers, then those patients should not need systemic resuscitation. But if you are in a position to warm them and keep them warm, then rapid re-warming is appropriate. The patient who should not be re-warmed is the patient who then is going to have to be taken out into the cold again, because the risk of re-injuring the tissue after re-warming and then cooling it again is worse than just keeping it frozen. Once the patient can receive definitive care, rapid re-warming in a water bath is still the treatment of choice.

**Watchful Treatment Still Acceptable for Cold Injury**

There are patients with extensive fourth-degree burns and at risk for tissue infection who would be appropriate for expeditious surgical removal of the tissue. For patients who have injuries to their distal extremities — fingers, toes, even the nose — I think that watchful treatment is still acceptable. The old
treatment or the old recommendation — freeze in January, operate in June — is probably out-of-date. The neuropathic pain these patients have is so considerable that, if you think they are going to require amputations, it is probably better to do it expeditiously as soon as they have declared the level of amputation necessary. You certainly do not want them to progress to the point where they develop soft tissue infections, so it is important to do appropriate wound care for those patients to keep the wounds clean and dry and allow them to demarcate the absolute level of tissue necrosis. It is remarkable how many patients actually can preserve their digits in spite of having what would appear to be a third-degree injury when they first present.

**Surgical Management in the Frostbite Patient**

There are some patients who have been out in the cold for a long period and may have a significant amount of soft tissue in their extremities — not limited to their toes and their fingers. It is obviously fourth-degree frostbite of their entire extremity. In that case, the risks of sepsis and soft tissue infection are significant enough that, if it is a fourth-degree injury, it is unlikely the patient is going to evolve and heal the wounds. In that case, there is no reason to wait before surgical management of the patient. It might be that your first operation is not going to be amputation. It may be the first is going to be an exploration of the wound to see actually how extensive the frostbite is.

**Case:** A patient presents with severe frostbite below the knee. The patient is now warmed, but function of that extremity is still non-existent.

**Recommendation:** If you can watch that patient for a few days and see which way they are going, I think that is a safe approach. I do not think any of these surgeries in the acute phase shortly after the patient presents have to be emergent, but I think the patient with a fourth-degree full extremity injury needs to have an honest conversation with their physician about the unlikelihood of them salvaging their leg or arm.

**Knowledge Growing of Long-Term Effects of Burn Injury**

Survival of burn patients has significantly increased, of which the burn community is proud. However, most of the burn community in the United States has underestimated what a chronic condition a burn injury is for a patient who has significant injury, >20%. The psychological manifestations of these injuries and even the functional recovery after these injuries difficult. We are beginning to understand that patients who have burn injuries still complain of neuropathic pain 5 or 10 years after their injuries. If you follow these patients and study patient-reported outcomes using quality-of-life tools such as the SF-12 instruments, many of these patients report poorer quality of life than the general public. I think it behooves the burn community to treat patients with burn injuries as if it is a chronic condition. Most of us would say to our patients, “Great, you look good. Your skin graft has taken. Your donor site has healed. You are back to work. You do not need to come and see me anymore.” But in fact, these patients still are having issues even 15 years after their injuries. We are seeing patients who were treated in the 1980s for instance, when they were young. Maybe you have a patient with a burn injury at age 19 who is now in his 50s or 60s. In order to get the full thickness burns off and in order to get these people rapidly excised and grafted, many of us had the approach where we would do fascial excisions. We are now finding the skin grafts we put on that fascia are breaking down, and patients are returning to us with chronic wounds and repeated injury to what had been a stable skin graft but now is showing signs of wear and tear. I had a wound developing and healed. Another wound developed; it healed. We are just now understanding what the long-term effects of burn injuries are.
Chronic Pain, Psychological Trauma Long-Term Risks in Burn Patients

Around the country, there is considerable variability in delivery of burn care as to the extent that psychologists are involved in their care. The other problem is that many patients who have sustained major burn injuries do not live in metropolises. They live in communities where people do not understand how to take care of burns. They do not understand the ramifications of burn injury. They do not understand the psychological sequelae. Some reports suggest that more than 50% of patients who have had a burn injury have secondary depression, similar to results with post-traumatic stress. When we send patients back to their communities, many of which are miles from burn expertise, we are subjecting them to a situation where they cannot get the help they need because people do not understand the consequences of a burn injury. Let’s face it, there are less resources in many of these non-urban areas.