By Patricia A. Connor-Ballard, PhD, ACNS-BC

Understanding and Managing Burn Pain: Part 1

Pain after burn injury is preventable, and nurses are central to achieving that goal.

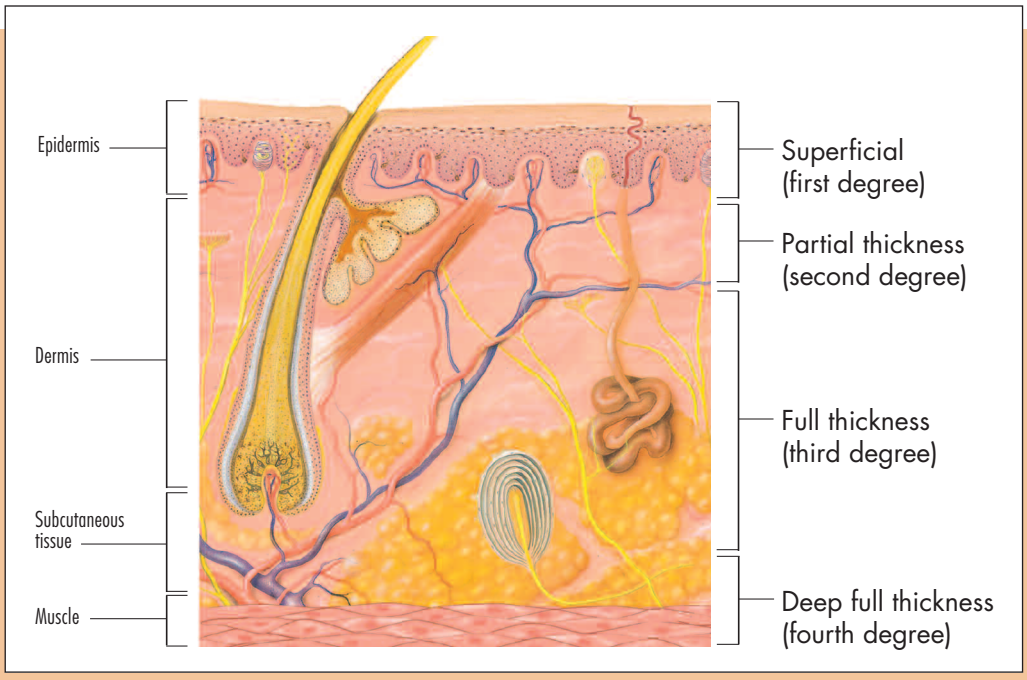
Overview: Burns are among the most intensely painful injuries. All patients will experience pain, regardless of the cause, size, or depth of the burn. Despite advances in topical wound care and pharmacology, and a growing emphasis on palliative care, wound care is the main source of the pain associated with burn injury. A deeper understanding of the many aspects of treating burns and their associated pain can help nurses to provide more effective analgesia. In this two-part article, the author explores burn pain and its treatment from a nursing perspective. Part 1 provides an overview of burn injury and addresses the wound care–related causes of burn pain as well as its assessment and treatment. Part 2 will address the psychosocial aspects of burn pain and will provide a more in-depth discussion of pain management and topical medications.

> *"When I first began working on a twenty-six bed burn unit eight years ago and was greeted by piercing screams from patients in pain, I was told by the staff that such suffering was an unavoidable consequence of therapeutic procedures and that higher doses of narcotics would cause respiratory depression and lead to addiction."*[1]

Depictions of burn injury in the media often dwell on the torments its survivors endure, perhaps unwittingly reinforcing the misperception that suffering is an inevitable part of daily wound care. The film *The English Patient*, for example, presents this kind of imagery: excruciating and uncontrolled pain, hideous disfigurement, intense psychological suffering. And some media reports on the care provided to veterans of the conflicts in Iraq and Afghanistan who have burn injuries have similarly suggested that providers do not or cannot effectively manage burn pain.

Pain is the common experience of all patients with burns—regardless of the cause, size, or depth of the burn—and the pain they experience can be among the worst known. But that doesn't mean that

Figure 1. Classification of Burns by Depth of Injury



burn pain can't be effectively managed. Advances in the past 60 years, including new analgesics, sedatives, and topical wound therapies, have resulted in more patients surviving burn injury that was previously considered fatal. Yet despite these developments, from institution to institution there's still great variability in the management of burn pain, often leading to its undertreatment.[2] Providers often don't understand all the factors that contribute to burn pain—for example, uncontrolled pain increases anxiety, which leads to lowered pain tolerance and continued suffering after burn injury.[3] Providers may also overemphasize concerns about using opioids to manage burn pain and may not understand the difference between opioid tolerance and addiction, which are not the same (nor is tolerance necessarily an indication of addiction; as long as there is a clinical need for the medication, it may be used, despite the fact that tolerance inevitably develops with prolonged use). In short, the intense suffering associated with burn injury, often at the hands of compassionate caregivers who provide wound care, has adverse effects on both patients and nurses.

The American Burn Association estimates that a half million people with burn injuries receive medical treatment each year, including 40,000 who require hospitalization.[4] The challenges facing providers in burn care include financial constraints imposed by inadequate insurance coverage, obstructions to the transfer of an injured patient to a regional burn center, and the need to educate all providers on disaster response. Burn injuries are costly because of the protracted length of recovery, the peaks and troughs in the patient's condition that result from repeated surgical procedures, and the high risk of complications. Timely transfer of the patient to a regional burn center can be impeded by poor weather and road conditions or limited availability of beds on burn units at the regional burn center. In the case of a patient with overwhelming burn injury who isn't expected to live more than a few hours, transfer to a regional burn center hours away may be not only unrealistic but unethical if it separates the dying patient from family members. Staff at the local hospital, with telephone guidance from the regional burn center, can be coached to care for the patient until transfer or death. See www.totalburncare.com/emergency_carepage.htm for burn unit referral criteria.

Disaster preparedness with a focus on handling burn injury is especially important for local hospitals. After terrorist attacks, natural disasters (such as the recent wildfires in Victoria, Australia), and large-scale conflagrations (such as the 2003 Station nightclub fire in West Warwick, Rhode Island), it's unrealistic to assume that a regional burn center could care for a massive surge of burn-injured victims. Local hospitals in such cases would have to provide burn care, regardless of their trauma level. Therefore, all acute care nurses need a basic knowl-

edge of burn care, including pain management.

BURN ETIOLOGY, SIZE, AND DEPTH

Burn injury is caused by contact with flame, steam, hot fumes, hot liquid, a hot surface, electrical current, or extremely acidic or alkaline chemicals. Exposure to ionizing radiation can also be a cause. Burn injury triggers both local and systemic responses, and the term *burn trauma* is often used to emphasize the injury's systemic effects. Unlike other types of trauma, in which pain diminishes over time, the interventions necessary to prevent infection and promote healing actually worsen the pain of burn injury.

While one might assume that large burns cause the most severe pain, even a small burn can be extremely painful. Burn size is measured as the percentage of the total body surface area (TBSA) affected by burns, both partial and full thickness. There are several methods of estimating burn size, including the rule of nines and the Lund–Browder chart. (Go to www.totalburncare.com/72hour_burn_assessment.pdf for an example of a burn size–estimation chart.)

The rule of nines divides the body into sections, each corresponding to 9% of the TBSA of an average adult, with the perineum and genitalia accounting for the remaining 1%. For example, the arm is considered 9% of TBSA; the anterior torso, 18% (an additional 5% is added for a pregnant woman in the last trimester); the posterior torso, 18%; and each leg, 18%. The rule of nines can be used initially, before admission, but burn size should be estimated again in the ED using a burn size–estimation chart that provides a more accurate assessment because it's age based, takes various burn depths into account, and divides the body into smaller sections. Because a child's body has different proportions than an adult's, the modified pediatric Lund–Browder chart should be used in children younger than 12 years of age. When scattered burns are present, burn size can be estimated by using the palm of the patient's hand, which represents about 1% of body size. Accurate burn size estimation is essential in calculating the patient's *minimum* fluid resuscitation needs within the first 24 hours after burn injury, using either the Parkland formula (4 mL × body weight in kg × percentage of TBSA burned = the amount of fluid in mL) or the modified Brooke formula (2 mL × body weight in kg × percentage of TBSA burned = the amount of fluid in mL), depending on the circumstances.

Superficial burns, which are unblistered, and *partial-thickness burns* (also known as first- and second-degree burns) are extremely painful. In a partial-thickness burn, the outermost skin layer (epidermis) and the uppermost third of the underlying skin layer (dermis) are damaged, and peripheral

Figure 2. Types of Burns

A. Superficial (First-Degree) Burn

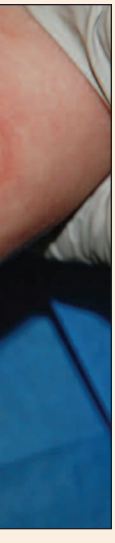
This child's arm shows reddened, dry, unblistered skin with mild edema (from the midforearm to the wrist). The injury is painful and hypersensitive to touch; damage results from momentary contact with a heat source and involves the epidermis and possibly the surface of the dermis. The burned skin blanches with light pressure. Healing usually occurs naturally within a week. Note that near the elbow is a raw area of an unroofed blister (in other words, a partial-thickness burn). All photos except that showing a superficial burn courtesy of Shriners Hospitals for Children, Boston. Photo below © Photo Researchers, Inc. ⬇

B,C. Partial-Thickness (Second-Degree) Burns

Photograph B shows a partial-thickness burn with an intact large blister. The burn can worsen into a full-thickness burn in 48 hours. Photograph C shows the same wound with an unroofed blister; the wound bed appears red, moist, and edematous. This burn is hypersensitive to touch, air, and temperature; damage to both epidermis and upper dermis results from limited contact with heat source. The burned skin blanches with pressure, but blanching can be slowed in a deep partial-thickness burn. Healing usually occurs naturally in two to three weeks. ⬇➡

E. Deep Full-Thickness (Fourth-Degree) Burn

Charred and hard to the touch (in the central brownish area), this wound results from the complete destruction of both the epidermis and the dermis, with damage possibly extending into underlying subcutaneous tissue, muscle, and bone. The burned area does not blanch. Surgery is required. ⬇



⬅ D. Full-Thickness (Third-Degree) Burn

This waxy white, tan, or charred, and possibly blistered, injury is insensate, although the area may be surrounded by painful partial-thickness burns (as pictured). Coagulated blood vessels are sometimes visible (although this is hard to see in dark-skinned patients). Edema and hair loss are always present to some degree. Complete destruction of both epidermis and dermis results from prolonged contact with heat source. Natural healing of small burns is possible but with risk of infection and scarring. The burned area does not blanch. Surgery is usually required.

nerve endings become exposed in the damaged dermal layer. A *full-thickness burn* (also known as a third-degree burn) results in complete destruction of both the epidermis and the entire dermis. A *deep full-thickness burn* (also known as a fourth-degree burn) extends past the dermis into underlying subcutaneous tissue, muscle, and bone. (See Figures 1 and 2.) Even after the skin is no longer in contact with the source of the heat, skin damage can continue as a result of protein denaturation (changes in the three-dimensional structure of the protein molecules). Without adequate assessment and initial treatment—for example, if fluid resuscitation is inadequate or hypoxia occurs—deep partial-thickness burns can convert to full-thickness burns within 24 hours of injury.[5]

In addition to the pain caused by direct tissue destruction, burn injury induces pain by stimulating both inflammation and hyperalgesia (extreme sensitivity to painful stimuli). The inflammatory reaction includes the secretion of histamine, bradykinin, and prostaglandin, irritating substances that stimulate the exposed peripheral nerve endings, producing additional pain. Manipulation of the hyperalgesic injury in the course of wound care also exacerbates pain.[2,6]

It was once believed that patients with full-thickness burns were insensate to pain at the site because nerve endings in the dermis were destroyed. Yet pain can indeed occur in what appears to be a full-thickness burn.[7] A burn wound may have areas of both partial- and full-thickness burns, and there may be areas where nerves are still functioning. Full-thickness burns are often surrounded by painful partial-thickness burns, and patients with full-thickness burns can also experience pain at the margins of the wound. An increase in pain in a full-thickness burn around the circumference of a limb may indicate a compartment syndrome–like process, necessitating escharotomy or fasciotomy. Finally, full-thickness burns require repeated painful procedures to prevent infection and promote closure with minimal disfigurement.

ADVANCES IN MANAGING BURN PAIN

The public and health care professionals became more aware of inadequate management of burn pain, despite advances in burn care, in the early 1980s, as the result of studies funded by the National Institutes of Health (NIH).[8,9] One hundred eighty-one respondents—physicians, nurses, and other providers—in 93 burn care centers in 37 states completed questionnaires. From my own experience and discussions with colleagues, I believe it's fair to say that Perry's findings were surprising, even shocking, to many burn care experts because they showed the degree to which treatment was inadequate and that there were no uniform standards for the treatment of burn pain. Although two-thirds of respondents claimed to use standard analgesics such as morphine and meperidine hydrochloride (Demerol) as the primary pain control method, the doses given varied, and most respondents still rated their patients' burn pain as moderate to severe in intensity. Only half of respondents used a sedative to reduce anxiety in addition to an opioid to control pain. Respondents with less than five years of burn care experience rated patient pain intensity higher than more experienced providers. The responses regarding management of burn pain in children were even more shocking: 24 (17%) stated that they would not use any opioid analgesia, and of these 11 stated that they would not use any pharmacologic agent at all. Yet the researchers noted that "despite the higher percentage of respondents who recommended using no narcotics or no psychotropics or no analgesia at all, the difference between the mean assessment of pain for children (2.9) and that for adults (3.0) [on a scale of 1 to 5, with 1 indicating no pain and 5 indicating excruciating pain] was not significant."[8]

It is possible that nurses' perception of patients' burn pain intensity becomes altered with time; such an alteration may be a coping mechanism.

However, the researchers also found that the burn units that did use opioids in the wound care of children tended to give them proportionally larger doses, compared with the doses adults received. "The tendency of those units working with children to give a larger relative dose of morphine stands in sharp contrast to the number of units not using analgesics for the debridement of children," they noted.[8] Only a small percentage of respondents were concerned about addiction to opioids in their patients, and the majority said that pain-management strategies at their facility were satisfactory in reducing burn pain. It is possible that nurses' perception of patients' burn pain intensity becomes altered with time; such an alteration may be a coping mechanism. Many nurses reported feelings of anxiety, depression, and helplessness while caring for burn patients who were in pain.

The findings of the NIH-funded study were not unique. In similar studies, veteran burn nurses often underestimated their patients' pain intensity and overestimated the effectiveness of opioid analgesia, and the correlation of nurses' and patients' ratings for pain intensity was poor.[10-14]

Nurses have long recognized the difficulties of

burn pain management. In 1989, after a discussion at the annual American Burn Association meeting, a group of burn-specialty nurses developed and implemented a national Delphi study to identify areas of concern in burn care (a Delphi study employs a series of surveys to allow a group of independent experts to reach consensus). Ninety-four nurses completed the four-part series of questionnaires and roundtable discussions. Burn-pain management was identified as a major concern in terms of patient welfare, nursing recruitment and retention, and nursing research. The project then examined the literature on burn pain management to identify current practice and implications for further research.[15] Management of burn pain in children was difficult, as was measurement of burn pain. There was inadequate published research on the effectiveness of opioid analgesia in managing "procedural" (treatment-related) burn pain. Although there was evidence to suggest the benefit of anxiolytic and anesthetic agents to supplement opioid use during wound care, their use was not routine practice.

In 1992 the Agency for Health Care Policy and Research (AHCPR, now the Agency for Healthcare Research and Quality), using a multidisciplinary panel and a methodical evidence-based approach, developed consensus guidelines for the management of pain after surgical and medical procedures and trauma.[16] The guidelines noted the following[17]:

> The myth that "third degree burns don't hurt" unfortunately still serves as a basis for widespread institutional denial of pain assessment and treatment for burned patients. Pain control is essentially absent from current reviews of burn management, scientific programs of national burn associations, or funding agendas of the Federal government or major private burn treatment organizations, much as pediatric pain and cancer pain were a decade ago.

The AHCPR recommended a combination of opioids and sedatives, with cognitive–behavioral strategies used as adjunctive therapy.

In more recent research using secondary data analysis based on the results from the *National Hospital Ambulatory Medical Care Survey* (1992 to 1999), Singer and Thode studied nationwide analgesia prescribing patterns in EDs caring for burn injury patients.[18] Findings indicated that almost half of burn patients in the United States did not receive adequate pain assessment or opioid analgesia in the ED (it's possible that patients received it during transport to the ED or refused it; excessive concern about opioid-induced respiratory depression or hypotension and fear of addiction may also have influenced ED practice).

Carrougher and colleagues examined patients' satisfaction with burn pain management during hospitalization.[19] Eighty-four patients gave twice-weekly reports on the "worst" and the "average" procedural pain they experienced, the average background pain they experienced in the previous 24 hours, their treatment goals for pain management, and their satisfaction with the management of their burn pain during hospitalization. Three-quarters of patients (74%) rated the worst procedural pain they experienced as being greater than 7 on a 10-point scale at least once during burn wound care. Patients reported that uncontrolled background pain was "less tolerable" than brief episodes of procedural pain. Of note, most patients reported that they would accept burn pain (either background or procedural) that they rated 6 or less on a 10-point pain intensity scale, because they believed that pain was inescapable following burn injury. Patients' pain-intensity scores correlated inversely with their satisfaction with pain management.

TREATING BURN PAIN

Pain activates the body's stress response and leads to pupil dilation, tachycardia, tachypnea, and elevated blood pressure and basal metabolic rate. Other perceptible indicators of pain include diaphoresis, grimacing or other exaggerated facial expressions, guarding and restricted movement of the affected body part, withdrawal from the source of pain, shallow breathing, tremors, and vocal expressions of pain and anxiety. However, the patient's experience of pain, with all of its unpleasant physical sensations and emotional components, is subjective (as McCaffery said, "Pain is whatever the experiencing person says it is, existing whenever he says it does."[20]), posing challenges to caregivers who assess and treat the pain—and must witness it and sometimes be its source. And pain serves a useful function when it warns of actual or possible tissue damage. Patients who lack pain sensations, as do those with diabetic neuropathy of the distal lower limbs, are at risk for burns and other injury.

Pain management in critical care can become problematic, for several reasons. For example, sedative and paralytic drugs do not provide analgesia, and the critically ill burn patient who is pharmacologically paralyzed and sedated for airway intubation and mechanical ventilation is unable to communicate. Without verbal communication from the patient, nurses must look for visible indicators of pain. In the past decade, nursing research has focused on using biometric parameters, such as vital signs, in combination with visual cues such as body position and movement for effective pain assessment of the intubated patient.[21-24]

Acute pain. Pain is defined as *acute* when its intensity diminishes over time and it lasts less than six months. But even during this period, acute burn pain can vary in etiology, character, and response

Online Resources

www.totalburncare.com

Maintained by Shriners Hospitals for Children–Galveston Burn Hospital and the University of Texas Medical Branch at Galveston, this Web site contains a wealth of information on "the varied physiological, psychological, and emotional care of acutely injured burn patients evolving through recovery, rehabilitation, and reintegration back into society and daily life activities." The purpose of the Web site is "to provide information on obtaining clinical care for burn victims, provide educational information on clinical care, describe research advances and activities, and provide an opportunity for further communication and contacts."

www.ameriburn.org

The American Burn Association is "dedicated to improving the lives of everyone affected by burn injury through patient care, education, research, and advocacy." A self-directed, Web-based learning program on advanced burn life support, ABLS Now, can be found at www.ameriburn.org/

to pain-relieving measures.[25] The causes of acute burn pain vary, as do the approaches to its assessment and treatment. Pain assessment and management in the critically injured burn patient who is intubated and mechanically ventilated will vary greatly from assessment and management in the discharged burn patient after the final skin graft. Recognizing the different phases of recovery from burn injury is the first stage in treating the many aspects of pain resulting from burns. For example, published pediatric-pain guidelines describe four separate patient categories for pediatric burn patients: "ventilated acute" burn patients, "nonventilated acute" burn patients, "chronic acute" burn patients (those with ongoing surgical needs a month after injury) and burn patients requiring reconstructive surgery; each category is associated with its own pain-related challenges.[2, 26] Although these pain categories and their treatment guidelines were developed for use in the pediatric burn population at Boston's Shriners Hospital for Children, future research could focus on how they might be modified for use in adult burn patients.

Chronic pain. Pain is considered to be *chronic* when it is persistent and its duration is longer than six months. Many patients with major burn injury require hospitalization for six months or more for numerous surgical debridements, skin grafting, and management of complications. Chronic pain is more common with burns of larger size or severity and may result from nerve entrapment within scar tissue. Major burn injury requiring limb or digit amputation can result in phantom pain syndrome. Chronic burn pain has been described as aching, painful paresthesia; stiffness; and increased sensitivity to touch and cold temperature. It may be more difficult to cope with than the more episodic and temporary nature of procedural burn pain. Patients have reported that chronic burn pain is often triggered by fatigue, mechanical pressure, increased joint movement, and changes in environmental temperature. Although it may lessen to some extent over time, chronic burn pain adversely affects the patient's ability to perform daily activities and sleep soundly. Recurrent exacerbations of chronic pain may be considered acute pain. Research on discharged burn patients has shown that many patients continue to experience pain at the location of their injury even after the wound heals.[27, 28]

Procedural and background burn pain. Acute burn pain follows a pattern of repeating peaks and troughs. *Procedural burn pain* is caused by wound care procedures, such as dressing removal, wound cleansing, debridement, skin grafting (including donor site care and the removal of surgical staples anchoring skin grafts into place), insertion and inflation of tissue expanders, passive range of motion exercises in affected joints, and splint application. Procedural pain is more severe than background pain and can be excruciating without adequate analgesia. Patients experience *background burn pain* between wound care procedures and often describe it as mild to moderate in intensity. It usually responds to typical doses of opioids or patient-controlled analgesia.

To prevent infection and sepsis, aggressive wound cleansing and topical antimicrobial therapy must be initiated immediately and repeated at least once per day. Daily wound care is continued as necessary for weeks to months until healing is complete. Hydrotherapy is used to vigorously flush the burn wound, cleaning the wound and removing loose, nonviable tissue. Most often, a shower gurney is used for this purpose. Because this method reduces the risk of infection, it is preferable to another form of hydrotherapy known as *tanking*, in which the patient is immersed into a tank of turbulent warm water. An antimicrobial soap such as Dial liquid soap or Hibiclens should be used, with water, to wash the burn wound before the application of any antimicrobial ointment.

Removal of adherent old gauze dressings and the exposure of wounds to the air can be painful for the patient who has not been adequately premedicated. Moistening the adherent dressings prior to removal will minimize patient discomfort. Sometimes flushing alone is inadequate for wound cleansing and mechanical friction using a wash cloth is necessary but painful. Timely opioid premedication by the oral route, 30 to 45 minutes before the start of the procedure, allows the analgesic effect to peak at the time of wound care. Additional medication can be

administered intravenously as necessary during the procedure to relieve breakthrough pain and anxiety. Both air and water temperature should be warm, but hot water should not be used for hydrotherapy. The patient should also be appropriately covered against ventilation drafts. Pain usually diminishes once the exposed wound has been covered with a topical ointment, dressing, or skin substitute.

The current standard of burn care is early debridement of eschar, followed by wound coverage by cadaver skin (allograft), patient skin (autograft), or synthetic dressing to reduce the risk of burn infection and sepsis. Manual debridement, often done by nurses or burn care technicians after wound cleansing, involves the scraping or pulling off of loose nonviable skin (such as ruptured blisters and bullae) from the underlying viable tissue using a wash cloth or tweezers and scissor. Deep surgical debridement to remove adherent eschar is performed under general anesthesia within three to five days after injury. Surgical debridement of large burns is delayed for several reasons: to allow the patient to recover from the severe fluid and electrolyte imbalance and metabolic shifts of burn shock, so that she or he can tolerate general anesthesia with less risk, as well as to allow sufficient time for the burn size and depth to become definitive. In patients who have multiple or large full-thickness burns, debridement is performed in a series of operations to minimize anesthesia risk and to prevent excessive bleeding. Enzymatic debridement using Travase or collagenase (Santyl ointment) has been used to remove small areas of eschar in an attempt to avoid surgical debridement, but some patients have reported the use of enzymatic therapy to be just as painful as traditional debridement.

Although there have been significant improvements in skin grafting for burns, the procedure remains an additional source of pain for those who undergo it.

After wound cleansing and manual debridement are performed, as necessary, a topical antimicrobial agent is applied. Despite advances in the development of topical burn care agents, several of those most commonly used today can add to the patient's pain. The ideal topical agent for burn wound care should be easy to apply and to remove, painless upon application, and hypoallergenic; provide long-lasting antimicrobial protection against both Gram-positive and Gram-negative bacteria as well as fungus; and be easy to store between applications as well as cost-effective. A topical burn care protocol that required application only once per day would reduce patient discomfort and overall cost.[29]

In full-thickness burn injury, surgical debridement of eschar is combined with skin grafting for wound coverage. Temporary (biosynthetic or cadaver) or permanent (autologous split-thickness or full-thickness) grafts may be used. Although there have been significant improvements in skin grafting for burns, the procedure remains an additional source of pain for those who undergo it. The patient returns from surgery with a painful burn wound that has been subjected to both debridement and grafting, as well as a painful skin donor site. Repeated skin grafting results in multiple donor sites. Repeated use of a single donor site delays grafting until the epidermal layer can regenerate, and the harvested skin is more fragile. The donor site is usually covered with gauze and an outer dressing. Over the next few days the outer dressing is removed and the gauze-covered wound is left open to the air. As the new skin grows, the gauze loosens at the edges and is trimmed. Clinicians have explored many dressing options that would reduce pain and allow for faster donor site healing, but as a rule, they are very costly. If the graft adheres, the painful procedure of removing surgical staples from the skin graft site often occurs on the fifth postoperative day. The experience of repeated surgical debridement and skin grafting, intermingled with daily wound care that includes cleansing and topical therapy, extends the patient's burn pain experience for weeks to months after the initial injury. ▼

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Patricia A. Connor-Ballard is the director of the Inova Learning Network and interim chief nurse executive for the Inova Health System, in Northern Virginia. Contact author: patricia.connor-ballard@inova.org. *The author of this article has disclosed no significant ties, financial or otherwise, to any company that might have an interest in the publication of this educational activity.*

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- plan the appropriate interventions for patients who have burn injuries.

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