Care of the Critically Ill Burn Patient: An Overview from the Perspective of Optimizing Palliative Care

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Conflicts of Interest: Dr. Campbell is employed by the Wayne State University and received royalties from John Wiley & Sons, Inc. Her institution received grant support from the National Institute of Nursing Research. Dr. Mosenthal received support for article research from the Healthcare Foundation of New Jersey. Dr. Puntillo is employed by University of California, San Francisco; received grant support from the Center for Health Quality and Innovation Quality Enterprise Risk Management program, a joint venture of the University of California Center for Health Quality and Innovation and Office of Risk Services; and received royalties from Elsevier for the book, Critical Care Nursing Secrets. Dr. Lustbader provided expert testimony for Medical Liability Mutual Insurance Company, Physicians Reciprocal Insurance (medical malpractice...
defense expert). The remaining authors have disclosed that they do not have any potential conflicts of interest.

**Author Contributions:** All authors made substantial contributions to the acquisition and interpretation of data (literature review). Drs. Ray and Karlekar drafted the manuscript; all authors made critical revisions to the manuscript and approved the final version for submission.

**Funding:** The Improving Palliative Care in the ICU (IPAL-ICU) Project was established with support from the National Institute on Aging (K07-034234 Academic Career Leadership Award to Dr. Nelson) and the Center to Advance Palliative Care.

**ATS Subject Category:** 2.13 End of Life/Palliative Care

**Running Head:** Palliative medicine and burn care

**Key Words:** end-of-life care; burn intensive care unit; burn care; palliative care

**Word Count:** 4282
Abstract

Burn specialists have long recognized the need for and role modeled a comprehensive approach incorporating relief of distress as part of care during critical illness. More recently, palliative care specialists have become part of the healthcare team in many US hospitals, especially larger academic institutions that are more likely to have designated burn centers. No current literature describes the intersection of palliative care and burn care or integration of primary and specialist palliative care in this unique context. This Perspective gives an overview of burn care; focuses on pain and other symptoms in burn ICU settings; addresses special needs of critically ill burned patients, families, and clinicians for high-quality palliative care; and highlights potential benefits of integrating primary and specialist palliative care in burn critical care. Medline and Cumulative Index to Nursing and Allied Health Literature were searched, and an email survey obtained information from US burn fellowships program directors about palliative medicine training. The IPAL-ICU (Improving Palliative Care in the ICU) Project Advisory Board synthesized published evidence with their own research and clinical experience in preparing this article. Mortality and severe morbidity for critically ill burned patients remains high. American Burn Association guidelines lay the foundation for a robust system of palliative care delivery, embedding palliative care principles and processes in intensive care by burn providers. Understanding basic burn care, challenges for symptom management and communication, and culture of the particular burn unit, can optimize quality and integration of primary and specialist palliative care in this distinctive setting.
Approximately 450,000 patients receive medical treatment for burn-related injuries in the United States each year, with about 3,400 deaths from such injuries. Of 40,000 hospital admissions for burns, three-quarters are to burn centers (1), among which half (about 60 centers) meet requirements of the American Burn Association (ABA “burn center verification”) (2). Guidelines developed by ABA with the American College of Surgeons include criteria for referring patients to burn centers, organizational structure, qualifications of medical personnel, and availability of specialists for consultation (3). On average, acute care hospitals—other than burn centers—care for fewer than 3 burn admissions per year.

Recent decades have seen decreasing mortality from burns (4, 5), attributed primarily to advances in overall critical care management and development of specialized burn care teams (6). Still, 25% of patients ages 45-64 with severe burns die, morbidity remains high for burn injury survivors, and sequelae impair quality of life from months to years, or permanently (7). Care for patients with severe burns is complex and requires a team that attends to physical, emotional, and spiritual needs of patient, family, and staff.

Specialized burn centers opened in the United States beginning in 1947 (8). Burn care was one of the first surgical specialties to focus on pain management and restoration of function, and has been described as “the most riveting and well-developed paradigm for surgical palliative care (9).” Burn specialists helped define the multidimensional nature of pain and the need for a comprehensive interprofessional approach incorporating relief of distress as part of care for critical illness and injury. Today, an increasing number of hospitals, especially large academic institutions that are more likely to have burn centers, also have palliative care consultation services that can help primary teams in intensive care units and elsewhere to
address challenges in management of pain and other symptoms across physical, psychological, and spiritual domains, mutually informed shared decision-making, family support, and transition planning (10).

This article addresses unique issues arising in burn unit palliative care. As context, we briefly review key aspects of current burn care practice and outcomes of burn injury. We then discuss management of pain and non-pain symptoms in burn critical care settings. Finally, we focus on integration of potential contributions from palliative care specialists with “primary” (i.e. non-specialist) palliative care by the burn clinical team (11).

**Approach to Evidence**

During April 2015 and again in Fall 2016, literature searches were performed in the bibliographic databases Medline and CINAHL (Cumulative Index to Nursing and Allied Health Literature) using the EbscoHost platform. The search results were not restricted by date range, but were limited to only English articles. A combination of MESH and CINAHL subjects and keyword terms were used along with Boolean operators. Some of the search terms used in various combinations were burns, burn units, burn patients, family, family relations, physician's role, nursing care, burn nursing, critical care, ICU, palliative care, end of life, nurse attitudes, critical care nursing, hospice and palliative nursing, nursing ethics, nurse-patient relations, professional-patient relations, physician-patient relations, professional-family relations, physician-nurse relations, stress, distress, depression, analgesics, opioid analgesics, methadone, non-narcotic analgesics, conscious sedation, hypnotics and sedatives,
hydrotherapy, attitude of health personnel, burnout. A total of 152 articles were identified and reviewed by 3 co-authors (DER, MBK, DLC), who summarized relevant evidence. We also conducted an email survey about palliative medicine training to program directors of burn fellowships. Our interprofessional and interdisciplinary Advisory Board of The IPAL-ICU (Improving Palliative Care in the ICU Project), comprising representation from medicine, nursing, and social work, and including surgical, medical, critical care, palliative care, and pediatric critical care specialists, synthesized the published evidence together with their own research and clinical experience in preparing this perspective article.

Burn Critical Care

Burns are initially assessed for size and depth, with attention to possible smoke inhalation and carbon monoxide or cyanide poisoning. The following criteria warrant consideration for transfer to an ABA burn center: >10% TBSA partial thickness burns; any size full-thickness burn; suspected inhalation injury; serious chemical injury; circumferential partial or full thickness burns; multiple comorbidities; high-voltage injuries; burns to face, hands, feet, perineum, and major joints; hospitals without qualified personnel; and patients who will require special social, emotional, or rehabilitative interventions (12).

In most ABA burn centers, patients are admitted to a dedicated critical care burn unit, where care is delivered by a team of burn surgeons, intensivists, anesthesiologists, nurses, physical therapists, nutritionists, and mental health specialists. Patients typically remain in these units until hospital discharge. For patients with burns on less than 90% of total body
surface area (TBSA) who die, hospital length of stay (LOS) is roughly 3 weeks (4). For those patients who survive, LOS is related to burn size and equivalent to 1 day per percent TBSA burned (4). Continuity of care in the burn unit helps promote physical, emotional, and psychological recovery of the patient, and positively affects the family’s recovery, but may also contribute to clinician distress (13).

**Burn Injury Outcomes**

Age, burn surface area, and inhalation injury are the main outcome predictors, but their weighting varies among scoring systems. The Beaux score predicts as follows: Mortality increases with age and TBSA burned; inhalation injury adds a 10-fold higher risk (4). The addition of non-burn specific measures (APACHE, SOFA, SAPS, and pediatric risk of mortality [PRISM] scores) has not been studied but may improve accuracy (14). Older patients (age >70) with burns greater than 40% TBSA and concurrent inhalation injuries are at particularly high risk of death (15-17). Overall, formal scoring systems are more useful for research than for bedside decision-making (14).

With decreasing mortality over the past 2 decades, outcome measures for burn injury and care have focused increasingly on functional status and health-related quality of life (6). “Recovery” to an acceptable quality of life is often more important than simple survival (18). However, meaningful recovery is defined differently by each individual, making such recovery a difficult construct to measure. Fewer than 30% of adult burn survivors return to work (19).
Care of the Burn Patient

A major burn represents a tremendous physiologic stress associated with anatomic, physiologic, endocrinologic, and immunologic alterations (20). The post-burn hypermetabolic response involves massive protein and lipid catabolism, total body protein loss, muscle wasting, peripheral insulin resistance, increased energy expenditure, and stimulated synthesis of acute phase proteins (21). This catabolic state can persist up to one year and is associated with impaired wound healing, increased infection rate, tachycardia, loss of lean body mass, slowed rehabilitation, and delayed community reintegration.

Robust randomized controlled trials are lacking for most strategies or treatments in burn care. Recommendations are based on observational data and/or expert opinions, and many remain controversial (22). Timely fluid resuscitation is the cornerstone of acute burn care (23), and has had the greatest influence on patient survival (20, 24). The challenge is to provide enough fluid to maintain perfusion without overload, which can cause pulmonary edema, myocardial edema, conversion of superficial into deep burns, need for fasciotomies in unburned limbs, and abdominal compartment syndrome (25). To address hypercatabolism, enteral nutrition is initiated within 6 to 12 hours (26).

Acute upper airway obstruction occurs in 20%-33% of hospitalized patients with inhalation injury, and progression from mild pharyngeal edema to complete obstruction can be rapid (27). Care remains supportive. Pneumonia is the most frequent medical complication of burns, especially in patients on mechanical ventilation over 4 days (12).
Strategies to reduce morbidity include early wound excision and closure, maintenance of body temperature by increasing ambient room temperature, high-carbohydrate and high-protein diet, and early physical therapy. Pharmacologic interventions include recombinant human growth hormone, low-dose insulin infusion, beta-blockade, and synthetic testosterone analogue (oxandrolone) (7).

Superficial burns do not typically require surgical excision. Early surgical intervention is recommended for deeper injuries that subsequently require allografting or autografting. Early escharotomy is performed to prevent tissue injury that can worsen edema and pressure leading to necrosis. Patients with large burns will require multiple surgical procedures over weeks to months for staged excision and grafting. These procedures are associated with significant pain, as well as blood loss, hypothermia, and cardiovascular stress (28).

Hydrotherapy has a long history in burn care, initially as the primary treatment modality but now as adjunctive therapy (29). Typically performed with an immersion tank or shower/sprayer, hydrotherapy uses water—with or without antimicrobial solutions—to facilitate dressing changes and debride residual topical agents, wound exudates, and necrotic tissue. Use of hydrotherapy is decreasing due to concern for nosocomial infection, decreased need to remove topical agents, and the associated pain and anxiety (29).

Once wound closure is achieved, patients are transitioned to inpatient rehabilitation. However, some deep wounds may not be amenable to any form of closure, necessitating amputation and long-term morbidity complicating physical and emotional recovery.
Pain and Non-pain Physical Symptoms

Pain is overwhelmingly the most prevalent and distressing symptom for the burn patient, and one requiring significant clinical expertise for professional caregivers. Pain varies greatly from patient to patient and can fluctuate tremendously over a hospital course (30). Due to complex interactions of anatomical and physiological changes influenced by psychosocial and premorbid behavior issues, burn pain can be highly unpredictable (31). Often, it is severe and persistent. Paradoxically, the intensity of pain is not necessarily directly related to the extent of the burn injury (30).

Damaging only the outer layers of skin, superficial partial thickness burns result in hyperalgesia and mild to moderate pain. Moderate partial thickness burns are associated with marked hyperalgesia, with moderate to severe pain from injury or activation of sensory receptors in the dermis. With deep partial thickness to full thickness burns, hyperalgesia is typically absent and pain minimal, though patients may describe a deep aching pain. Pain is experienced at the transition zone between burned and non-burned skin (30).

Burn pain can be characterized in 5 phases (32). Patients experience background pain from thermal injury and tissue destruction, which is typically low to moderate in intensity and of long duration. This is contrasted with intense pain from procedures such as wound debridement, dressing changes, hydrotherapy, and physical therapy. Unexpected breakthrough pain can occur at rest or during procedures, while postoperative pain occurs after burn excision or creation of new and painful wounds from skin harvesting and grafting. Optimal pain control is imperative for wound healing, restorative sleep, participation in daily living, and therapy.
Poor pain control has been associated with depression, posttraumatic stress disorder, substance abuse, and suicidal ideation (33).

Neuropathic pain after burn injuries is common, and occurs throughout the course from acute injury to recovery. It becomes more prominent as the primary cause of pain in the later phase of recovery when the acute burn injury has healed. Symptoms may include burning, stabbing, shooting, or electric sensations (34-36). Incidence of localized and peripheral neuropathies ranges from 15% to 37% (7), likely caused by combinations of direct thermal injury, circulating neurotoxins, changes in distribution of fluid and electrolytes, compression by bulky dressings, and stretching of peripheral nerves with improper positioning for prolonged periods. Age, electrical burns, diabetes, and length of ICU stay increase risk for neuropathies (7).

There is insufficient evidence to support a uniform approach to pain management (37). Because physiologic changes alter pharmacokinetic and pharmacodynamic responses to drugs, treatment of pain can be challenging (38). Thus, traditional approaches to ICU treatment of pain may need to be modified for burn patients, including changes in dosing and dose frequency (31). Dosing and physiologic considerations for opioid analgesics can be found in recent reviews (39-41). Non-opioid analgesic considerations are in Table 1 (41-58). Although pain assessment and management is a fundamental principle and a focus for clinicians in the care of patients with burn injuries, pain is still often inadequately controlled (31). Burn care requires the most rigorous, reliable, consistent, and efficient work processes for assessment and management of pain, with ongoing monitoring of performance and quality.
Continuous or long-acting opioids are the standard for treatment, with short-acting opioids for breakthrough pain (59). Many burn patients develop opioid tolerance necessitating higher doses than in standard non-burn ICU guidelines. During the acute burn injury, there is increased sensitivity to pain induced by the acute inflammatory response in burned tissue (hyperalgesia). Central nervous system adaptation to prolonged pain or repeated acute pain may amplify the pain experience and result in prolonged hyperalgesia that is unpredictable. Hyperalgesia may also be opioid-resistant (30). Slow and careful taper of opioids during the healing process is essential in preventing drug withdrawal (60). There is little role for acetaminophen and non-steroidal anti-inflammatory medications in treatment of severe burn pain (49).

Despite opioid medication, most patients being treated for severe burns report severe to excruciating pain during wound care, particularly with hydrotherapy (61). Conscious sedation is frequently utilized (25). Ketamine or dexmedetomidine can be used for short-term analgesia and sedation during complicated dressing changes (42-45), while anxiolytics are often used during painful procedures (51, 52). Propofol can be used for mechanically ventilated patients but offers no analgesic effects (46-48). Pregabalin has shown some efficacy in treatment of late-phase neuropathic pain (56, 57).

Regional anesthesia is particularly useful for procedures and burn pain relief involving extremities (30). Spinal or epidural opioids can provide background, procedural, and postoperative pain relief. A major drawback to neuraxial anesthesia is associated risk of meningitis and epidural abscess with insertion through burned skin (30).
Non-pharmacologic techniques such as massage, hypnosis, multimodal distraction, cognitive-behavioral techniques, music therapy, and virtual reality games have shown efficacy in reducing pain during wound care (30). Pruritus, neuropathies, anxiety, sleep disturbance, depression and posttraumatic stress augment perception of pain (7).

Pruritus occurs in up to 70% of patients at one year after burn injury and can persist for decades (62, 63). There is no strong empirical evidence on treatment efficacy (64), but multiple treatment options are described (7, 54). Antihistamines are the mainstay and include topical, oral, and parental preparations (55). Gabapentin and pregabalin have shown efficacy for pruritus (54, 55, 57).

Other complications during recovery from burns include hypertrophic scarring, ultraviolet sensitivity and skin pigmentation, and bone and joint changes from disruption of bone metabolism. Musculoskeletal complications include hypertrophic ossification, scoliosis and kyphosis, septic arthritis, subluxations and dislocations of joints (especially in hands and feet), and amputation (7).

**Psychological Symptoms**

Significant psychological distress is common after major burn injuries, and associated with greater physical and functional impairment (65, 66). The 2 major psychological issues affecting burn survivors are depression and posttraumatic stress disorder. Depression ranges from 4% at discharge, to 54% at 1 month after discharge, to as high as 10%-20% at 1 year (6). Rates of
posttraumatic stress disorder are 6%-33% at 1 year after injury, similar to survivors of general critical care units, who have an incidence of 4%-62% (67).

The emotional morbidity resulting from burn injuries is dependent on age, preexisting psychopathology, economic status, and genetic determinants (68-70). Virtually all burn survivors, especially adolescents, have difficulty with body image, self-esteem, mood regulation, cognitive mastery, success in school, and intimate relationships (7). Psychiatric problems such as attention deficit/hyperactivity disorder, PTSD, phobias, sleep disorders, dementia, autistic spectrum disorders, personality disorders, and somatization disorder are common comorbidities in burn patients, often being exacerbated in the recovery (71). Self-inflicted burn injuries, although less than 1% of all burns, are particularly difficult for patients, families, and staff. The majority of individuals with self-inflicted burns survive, posing complex challenges for treatment and post-discharge rehabilitation. Most of these patients have acted impulsively in the context of psychiatric or alcohol/drug disorder or may have reacted to stressful life events. Survivors can be successfully rehabilitated with early psychiatric and social interventions (72).

**Stress for Informal and Professional Caregivers**

Little research focuses on impact of a patient’s injury on family, but it is clear that family members can be radically affected after burn-related critical illness, which begins suddenly but often continues for a protracted period. Families manifest moderate to severe anxiety and
depression after burn injury of a loved one. These symptoms usually abate over the first year (73, 74).

Stressors for those working in a burn center are tremendous. Studies on professional burnout and other forms of clinician distress that were conducted in non-burn ICU settings may also apply to those providers working in burn units (75, 76). Emotional exhaustion, depersonalization, and reduced sense of personal accomplishment can have a marked influence on personal, interpersonal, and organizational performance (77). Moral distress can result in depression, anxiety, emotional withdrawal, frustration, anger, and physical symptoms (78). While no healthcare professional is immune, most of the experience to date has been reported by nurses (79). Factors including religious beliefs, commitment, and sense of control over the environment modify the personal experience. Patient characteristics may either reduce or intensify these responses (15).

However, the majority of nursing staff in a burn critical care unit do not experience emotional exhaustion or display higher rates of depersonalization than nurses in other ICUs; rather, they perceive higher levels of personal accomplishment (80). Emotional exhaustion is more evident when the nurse believes care is futile or conflicts with the nurse’s values and standards related to the patient’s expected outcome (13). Factors that minimize caregiver stress are interprofessional support and unity, especially regular debriefing sessions and a team culture that encourages use of employee assistance programs (81).
**Pediatric Considerations**

Although primary treatment approaches are similar, pediatric burn patients require special consideration. Diligence in bedside clinical observations such as mental status, temperature, appearance of extremities, and capillary refill are imperative in evaluating the efficacy of resuscitation and determining ultimate outcome in the pediatric population (28). Consideration of pain, neurocognitive development, family support, nature of the burn, and anticipated recovery and long-term outcome are major components contributing to pediatric burn care. Importantly, family support influences psychosocial adjustment after burn injury in the pediatric population (82, 83).

**Primary and Specialist Palliative Care for the Burn Patient**

Palliative care is an interprofessional subspecialty as well as an approach to care for people facing serious and complex illness, including critically ill and injured patients and their families (84). It is provided along with curative/restorative treatment to relieve basic symptoms, foster effective communication and patient-focused decision-making, improve quality of life for both the patient and family, and support the primary plan of intensive (and other) care. Another important domain of palliative care in the ICU is support for professional caregivers facing the daily and cumulative challenges of caring for our sickest and most vulnerable patients and their families (85). Integration of palliative care principles and processes is increasingly recognized as a standard of high-quality, comprehensive critical care (86, 87).
Primary palliative care represents the basic competencies required by all clinicians caring for patients with serious and complex illness—skills and knowledge to manage uncomplicated symptoms; discuss goals of care in relation to the patient’s condition, prognosis, and values; and support families (11, 88). Specialist palliative care is provided by an interprofessional team of consultants when needs are more complex and/or refractory to primary treatment. (88, 89) Palliative care specialists can also help educate, coach, and support clinicians to optimize primary palliative care.

Experts advocate integrated delivery of both primary and specialist palliative care in ICUs and other settings (11, 88). Primary clinicians such as burn critical care teams are committed to and responsible for palliative care delivery, and have the most continuous and, usually, the most trusted relationship with patients and families. Established national standards for burn care promote a team approach that is patient- and family-centered, emphasizes the importance of continuity of care from injury to recovery, and confirms competency of burn team members (12). Overall, the interprofessional or interdisciplinary approach by burn clinicians is similar to that of palliative care teams. Primary palliative care is also essential because, despite rapid growth in palliative care consultation programs, there is and will be a significant, global workforce shortage of palliative care specialists across professions (90). Current estimates are that 20,000 more such specialists are needed in acute care hospitals, while only slightly more than 250 physicians graduate from palliative medicine training programs each year (90). Where available, palliative care specialists have varying levels of specific expertise with burn palliative care, depending on their exposure to and engagement in such care in the course of their consultative work.
At the same time, even burn program academic leaders have recognized deficiencies in palliative care training for burn fellows. In 2015, a survey was sent to directors of the 35 burn fellowship programs (Table 2) in the U. S. Most of their institutions have access to a specialty-level palliative medicine consultation service, with many also having palliative medicine fellowship programs. Ninety percent of responding directors endorsed the importance of training for burn fellows in palliative medicine, identifying the following competencies as most relevant: formulation of prognosis, communication of serious news and disclosure of death, advance care planning, limitation of treatments for which burden exceeds benefit, and management of the imminently dying patient. However, only one-third of the burn fellowship directors reported inclusion of these competencies in their formal curricula. As reported by burn program directors, respondents attributed these gaps primarily to what they perceived as insufficient interest among burn faculty and fellows in palliative medicine education, and inadequate curriculum development in burn surgery.

In addition, more than 10,000 burn patients each year are treated in acute care hospitals that are not ABA-verified burn centers (1). In these institutions, intensivists, surgeons, and other clinicians may have less experience, expertise, and/or infrastructure for comprehensive burn care including palliative care.

In any of these settings, palliative care personnel can help address gaps by collaborating to develop curricula, assist in education and training, and provide other support to ensure delivery of high-quality palliative care (Table 3). This role may be particularly valuable in the context of communication, which presents special challenges. All burn injuries are sudden, and patients’ and families’ ability to process information communicated by clinicians is often
seriously compromised (91). Communicating with patients and families has long been identified as an important physician competency. A literature review conducted by the National Board of Medical Examiners found significant evidence supporting positive associations between physician communication and patient outcomes (92).

Until the Milestone Project by the ACGME (93), however, advanced communication skills training was not required in any surgical specialty. The ACGME published a communication guide to help inform content for this clinical competency, but did not provide pedagogical guidance to educators (94). The American College of Surgeons recently recommended creation of educational and training programs for surgeons in advance care planning, shared-decision making, and communication skills (95). Palliative care specialists can provide invaluable support for these programs, working with burn teams to develop resources and approaches, and to provide training, role-modeling, performance feedback, and mentoring. They can also facilitate development of policies or protocols for burn teams and acute care hospitals to optimize end-of-life care, such as comfort care pathways and protocols for limitation of life support. In addition, in burn ICUs as in other critical care settings, specialists in palliative care can provide support for clinicians to promote resilience and mitigate emotional and moral distress and burnout.

When available and appropriate, specialist palliative care teams can also provide an extra layer of support directly to burn patients and families in the ICU. Local culture and expertise currently determine the nature and extent of engagement of these consultants, leading to considerable variation in practice patterns across institutions. To enhance access to palliative care specialists, criteria for referral can be developed in collaboration with the burn.
team. Such criteria may be modeled on those used in other critical care settings (e.g., need for clarification of goals of care, refractory pain or other symptoms) (84, 89, 96-98), and/or may be framed in terms of factors specific to burn injury such as Beaux score, TBSA burned, comorbidities, or presence of inhalation injuries. Ideally, criteria for specialist engagement will reflect potential contributions by palliative care consultants not simply to care at the end of life but to care meeting a broader range of symptom, communication, and other needs. In addition, the system of referral should reflect the reality that each patient and family has unique needs and that burn teams have varying levels of primary palliative care knowledge and skill.

Ultimately, successful integration of primary and specialist palliative care in the burn ICU will depend on the burn team’s perception of the value of the referral and follow-up on recommendations, which in turn will be influenced by consultants’ responsiveness to and respect for burn clinicians (99). Curiosity and receptivity on the part of palliative care specialists for education and experience in the unique challenges of burn care will also be important. The goal is to support burn teams to provide high-quality primary palliative care, while ensuring access to specialist palliative care for patients and families when needed, and promoting resilience and professional gratification among burn providers. This combined model can improve ICU palliative care and reduce utilization of resources without increasing mortality (88, 100-104).
Conclusion

Although advances in burn care have driven down mortality (4), morbidity due to burn injury with prolonged hospital stays remains high. ABA guidelines (3) have laid the foundation for a robust system that embeds palliative care principles and processes in burn intensive care by the primary providers. Working with burn teams, palliative care specialists can enhance this primary palliative care and meet more complex needs of patients, families, and even burn clinicians themselves. Understanding basic care for burn injuries, special challenges of symptom management and communication in burn care, and the culture of the particular burn unit can optimize the value of palliative care consultation in the unique environment of complex burn care. Future research should specifically investigate palliative care needs of patients and families in burn units, and the impact of primary and specialist palliative care on outcomes of importance to burn patients, their families, and providers (105).
Acknowledgements

The authors gratefully acknowledge the contributions of Jacqueline Grove in manuscript editing and preparation and of Jennifer Allen, MD, in survey development, distribution, and analysis.
References


Table 1. Non-opioid pharmacologic medications in burn care

<table>
<thead>
<tr>
<th>Agent</th>
<th>Half-life</th>
<th>Dose</th>
<th>Use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine (IV)</td>
<td>2-3 h</td>
<td>0.1-0.5 mg/kg loading dose, then 0.05-0.4 mg/kg/hour</td>
<td>Short-term analgesia and sedation for procedures</td>
<td>McGuinness, 2011 (42) Barr, 2013 (41)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Attenuate hyperalgesia and ineffective opioid analgesia</td>
<td></td>
</tr>
<tr>
<td>(PO)</td>
<td></td>
<td>5 mg/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dexmedetomidine</td>
<td>3 h</td>
<td>1 mcg/kg over 10 min loading dose, the 0.2-0.7 mcg/kg/hour</td>
<td>Short-term analgesia Sedation for procedures in children</td>
<td>Lin, 2011 (43) Walker, 2006 (44) Kundra, 2013 (45)</td>
</tr>
<tr>
<td>(IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(PO)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Propofol</td>
<td>1.5-31 h</td>
<td>4 mcg/kg</td>
<td>Dense analgesia/anesthesia</td>
<td>Barrientos-Vega, 1997 (46) Tosun, 2008 (47) Han, 2009 (48)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 mcg/kg/min initial dose then titrate by 5-10 mcg/kg/min, maximum dose of 80 mcg/kg/min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>2 h</td>
<td>325-650 mg every 4-6 hours, not to exceed 4 g/d</td>
<td>Non-inflammatory induced mild pain</td>
<td>Richardson, 2009 (49)</td>
</tr>
<tr>
<td>NSAID</td>
<td>Variable</td>
<td>Drug dependent</td>
<td>Not suitable for treatment of severe burn pain</td>
<td>Richardson, 2009 (49)</td>
</tr>
<tr>
<td>Risperidone</td>
<td>20 h</td>
<td>0.5-2.0 mg at bedtime</td>
<td>Acute stress symptoms</td>
<td>Stanovic, 2001 (50)</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>1.5-2 h</td>
<td>1-2 mg IV/PO every 2-6 hours as needed</td>
<td>Insomnia due to anxiety Generalized anxiety Severe agitation Alcohol withdrawal Analgesic effect when combined with opioid</td>
<td>Patterson, 1997 (51) Carrougher, 2006 (52)</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>5-7 h</td>
<td>100 mg oral 3 times/d starting dose. Titrate up to 5 mg/kg oral 3</td>
<td>Pruritus Not effective in acute pain</td>
<td>Wibbenmeyer, 2014 (53) Anand, 2013 (54)</td>
</tr>
<tr>
<td>Drug</td>
<td>Half-life</td>
<td>Treatment Details</td>
<td>Indication</td>
<td>Reference</td>
</tr>
<tr>
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<td>-----------------</td>
</tr>
<tr>
<td>Pregabalin</td>
<td>5.5-6.7 h</td>
<td>50 mg oral 3 times/d starting, increase to 100 mg oral 3 times/d</td>
<td>Late onset neuropathic pain</td>
<td>Goutos, 2009</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pruritus</td>
<td>(55)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Barr, 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(41)</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>1.5-2 h</td>
<td>1.5 mg/kg loading dose, 1-2 mg/kg/h</td>
<td>Generalized anxiety</td>
<td>Wong, 2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Analgesia</td>
<td>(56)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ahuja, 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(57)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wasiak, 2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(58)</td>
</tr>
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</table>
Table 2. Palliative Medicine Competencies in Burn Fellowship Training:
Survey of Program Directors

<table>
<thead>
<tr>
<th></th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents</td>
<td>11/35 (31%)</td>
</tr>
<tr>
<td>Respondents’ institution</td>
<td></td>
</tr>
<tr>
<td>has Palliative Medicine Consult Service</td>
<td>10/11 (91%)</td>
</tr>
<tr>
<td>has Palliative Medicine Fellowship Program</td>
<td>7/11 (64%)</td>
</tr>
<tr>
<td>Burn fellowship led by respondent offers formal training in palliative care competences</td>
<td>4/11 (36%)</td>
</tr>
<tr>
<td>Training in primary palliative care for burn fellows is important</td>
<td>10/11 (91%)</td>
</tr>
<tr>
<td>Specific competencies felt to be most important</td>
<td></td>
</tr>
<tr>
<td>• Formulation of prognosis</td>
<td>10/11 (91%)</td>
</tr>
<tr>
<td>• Difficult communication/breaking bad news/death disclosure</td>
<td>11/11 (100%)</td>
</tr>
<tr>
<td>• Advance care planning</td>
<td>11/11 (100%)</td>
</tr>
<tr>
<td>• Limitation of non-beneficial treatments</td>
<td>10/11 (91%)</td>
</tr>
<tr>
<td>• Management of imminent death</td>
<td></td>
</tr>
<tr>
<td>Barriers to palliative care education/training for burn fellows</td>
<td></td>
</tr>
<tr>
<td>• Insufficient interest among burn faculty</td>
<td>8/11 (73%)</td>
</tr>
<tr>
<td>• Insufficient interest among burn fellows</td>
<td>6/11 (55%)</td>
</tr>
<tr>
<td>• Inadequate palliative care curriculum development in burn surgery</td>
<td>6/11 (55%)</td>
</tr>
</tbody>
</table>
Table 3. Potential Areas for Valuable Contributions by Palliative Care Specialists in Burn Critical Care

- Facilitate communication in situations of prognostic uncertainty, complex family dynamics, and death disclosure
- Collaborate in the management of the imminently dying patient
- Provide an extra layer of support directly to burn patients and families in the ICU
- Assist in the training and role modeling of primary palliative medicine skills
- Support palliative care curriculum development for burn critical care education
- Facilitate development of policies or protocols around withdrawal and withholding of non-beneficial treatments
- Promote resilience and mitigate distress among burn team clinicians