Principles of Burn Pain Management

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KEYWORDS

• Pain burn pathophysiology • Adjuvant pain medications • Alternative pain therapy
• Opioid-based analgesia • Opioid tolerance • Opioid-induced hyperalgesia • Multimodal analgesia
• Patient-controlled analgesia

KEY POINTS

- Successfully managed acute pain improves trauma-related morbidity and mortality, and is associated with decreased likelihood of development of psychiatric comorbidities and chronic pain conditions.
- Proper pain assessment and monitoring, including frequent treatment plan and dose adjustments, is of primary importance.
- Opioid requirements of burn patients, in particular those with prior history of opioid use, substantially exceed average dosing recommendations. Identification of opioid-tolerant burn patients early in course of treatment improves analgesic outcomes.
- Opioids remain the cornerstone of acute pain treatment but should not be used as monotherapy.
- Multimodal pain management, including adjuvant pain medications, interventional blocks, alternative therapies, psychological counseling, physical and occupational therapy, results in optimal treatment outcomes and should be continued long term, even after the time of discharge.

Managing pain in a patient with burn injury can be complex. Pain that originates with burn injury is generally classified temporally, first as the pain in the acute process, then as the pain in the chronic phase when the bulk of tissue healing has occurred.

THE MECHANISM OF PAIN IN BURNS

The skin contains nociceptors that respond to heat and mechanical and chemical stimulation. Thermoreceptors interpret temperatures above 42°C as painful. Mechanoreceptors respond to changes caused by physical interactions, such as pressure of vibration. Chemical nociceptors are activated by endogenous chemicals, such as those released during an inflammatory process (ie, histamine, leukotrienes, and substance P), or exogenous chemicals, such as contact with caustic of acidic materials.

In the immediate postburn injury period, tissue injury causes release of inflammatory mediators. These mediators sensitize the nociceptors at the area of injury. Pain transmission is facilitated by C-fibers, which are unmyelinated, and A-delta fibers, which are thinly myelinated. These signals are transmitted to the dorsal horn of the spinal cord. The clinical result is that the site of the injury is sensitized to all stimuli.[1] Clinically, this is experienced as increase sensitivity to touch, such as with wound care and topical agent administration in the area that is injured. This is called primary hyperalgesia.

Soon afterward, the area surrounding the area of tissue injury also becomes sensitized. This is called secondary hyperalgesia. This is thought to

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be mediated by the spinal cord and due to sensitization of a lager nociceptive field from continuous afferent firing by nearby nociceptors.

DEPTH OF TISSUE INJURY AND PAIN

Burn severity is classified by the extent of involvement in body surface area affected and depth of skin injury. In first-degree burns, tissue injury is superficial and involves only the epidermis. Pain associated with this is generally mild to moderate and healing occurs within a week.[2]

Second-degree burns involve parts of the dermis. These are thought to be painful because there is damage to skin nociceptors and exposure of nerve endings. With healing, nerve regeneration can be disordered, leading to neuropathic pain.

Third-degree burns involve destruction of nociceptors and can make the affected area insensate. It would seem then, that these injuries should not be painful. However, in reality, deep burns contain areas of more shallow burn where nerve endings have not been completely destroyed; thus even full-thickness burns are painful.[3]

CATEGORIES OF BURN PAIN

There are 2 categories of pain experienced in burn injury.

Evoked and procedural pain occurs with predictable events, such as after a procedure, or with activities such as movement, physical therapy (PT), or dressing changes. This is generally short-lived but high in intensity.

Background pain is experienced without provocation and is present even at rest. Generally, it is thought to be less intense than evoked pain but, in contradistinction, it is constant. It can have spontaneous exacerbations with no known reason.

Inpatient Pain Management

The acute phase of burn pain management generally takes place in an inpatient setting. In a burn patient, the experience of pain is that of a chronic baseline pain negatively accentuated by frequent procedures such as surgeries, dressing changes, and procedures. Periprocedural pain often escalates, requiring an individualized treatment plan involving continuous monitoring, reassessment, and analgesic dose adjustments. In addition to this constant nociceptive input, the anticipation of pain leads to psychological trauma, which further intensifies the pain perception. Perioperative and periprocedural pain management is important because adequate pain management decreases morbidity and mortality, as well as the likelihood of development of persistent postoperative pain. Inadequate pain control is also associated with a wide range of psychiatric conditions, including post-traumatic stress disorder (PTSD), depression, anxiety, and sleep disorders. Effective analgesia facilitates patient participation in rehabilitation and recovery.

OPIOIDS

Opioids remain the mainstay of treatment, especially in the acute phase of burn pain, and are the most efficacious medication in perioperative moderate and severe pain management. Opioids come in a variety of routes of delivery (by mouth, intravenous [IV], transdermal, sublingual, rectal) and formulations (short-acting, long-acting), which allows for flexibility of administration. Opioids are thought not to have a ceiling effect, thus they can be escalated to a therapeutic effect unless side effects preclude further dose escalation. Unlike other analgesics, opioids do not lead to renal or hepatic dysfunction, though choice of agent and dosing should include consideration of the patient's comorbidities.

Opioids, however, can cause a multitude of side effects that are often related to dose. These can range from simply bothersome effects, such as constipation, nausea, and itching, to severe effects, such as respiratory depression leading to death. Respiratory side effects may be especially pronounced in patients with pre-existing conditions such as sleep apnea, pulmonary comorbidities, and obesity. The incidence of side effects in patients managed for acute pain with opioids is high, with some studies finding that up to 92% of patients experience at least 1 side effect and 76% of patients experience 2 or more side effects.[4]

Despite increased risk of side effects, significant opioid dose escalation may be required for burn patients with extended hospital stays, patients requiring frequent procedures, or those with a history of prior opioid use or abuse. To optimize analgesic outcomes and decrease the likelihood of opioid-related side effects, patients should undergo frequent pain reassessments with judicious dose escalation, which are particularly important during the acute phase of injury and in the immediate postoperative period. Opioid-related side effects are less likely to occur with frequent small dose changes as opposed to infrequent large dose changes.

Tolerance and Opioid-Induced Hyperalgesia

With prolonged opioid use, changes in the central nervous system occur, leading to a decrease in