ACS TRAUMA QUALITY PROGRAMS

BEST PRACTICES GUIDELINES FOR ACUTE PAIN MANAGEMENT IN TRAUMA PATIENTS

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INTRODUCTION

The majority of trauma victims experience pain.[1] Acute pain can impact respiratory function, increase metabolic demand, impair wound healing, suppress immunity, and reduce mobility. Inadequate acute pain management after trauma delays return to work, lowers quality of life, and increases post-traumatic stress disorder (PTSD) risk.[2] Poorly managed acute pain also increases the risk of chronic pain development. Nearly two-thirds of patients report at least moderate pain 12 months after injury, and three in four report pain interference with activities of daily living, such as social engagement, work, and cognitive and emotional function.[3] Pain is associated with decreased self-efficacy and increased risk of depression. This effect may be more pronounced after trauma, because traumatic events cause distress that can exacerbate pain, triggering a trauma-pain-distress feedback loop.

For all patients, the goal of pain management is a tolerable pain level that allows the patient to function, not "zero pain." General guiding principles for pain management exist and apply across the continuum of care; however, unique environments and patient populations present distinct challenges and opportunities that prevent a one-size-fits-all approach. For example, care in the emergency department is often complicated by a lack of detailed patient information; response to pharmacotherapy is altered by organ function in geriatric and pregnant patients; and pain management goals can change drastically at end-of-life.

Pain management changed over the last decade, in large part due to the opioid crisis in the United States. The scope of the opioid crisis—and the impact of prescription drugs—resulted in a call from the American Medical Association (AMA), the Orthopaedic Trauma Association (OTA), and the American College of Surgeons (ACS), among others, to minimize opioid use.[4,5,6] New research supporting the safety and efficacy of nonopioid analgesia drives innovative practices within trauma centers across the country, pushing providers and programs to deliver better care.

This publication is intended to provide an evidence-based, practical guide to acute pain management of the trauma patient. It begins with an overview of pain physiology, pain assessment, pharmacologic analgesia, nonpharmacologic pain management, and regional analgesia. Then considerations for pain management across unique phases of care are provided, from prehospital care through patient discharge. A discussion of acute pain management in special populations follows, including older adults, children, pregnant patients, patients with depression and mood disorders, those on chronic opioid therapy, and patients at the end of life. Finally, we issue a charge to trauma centers across the United States to strive for continual improvement in pain management, with steps for implementation.

Important Note

The intent of the ACS Trauma Quality Programs (TQP) Best Practices Guidelines is to provide health care professionals with evidence-based recommendations regarding care of the trauma patient. The Best Practices Guidelines do not include all potential options for prevention, diagnosis, and treatment, and are not intended as a substitute for the provider's clinical judgment and experience. The responsible provider must make all treatment decisions based upon their independent judgment and the patient's individual clinical presentation. The ACS and any entities endorsing the Guidelines shall not be liable for any direct, indirect, special, incidental, or consequential damages related to the use of the information contained herein. The ACS may modify the TQP Best Practices Guidelines at any time without notice.

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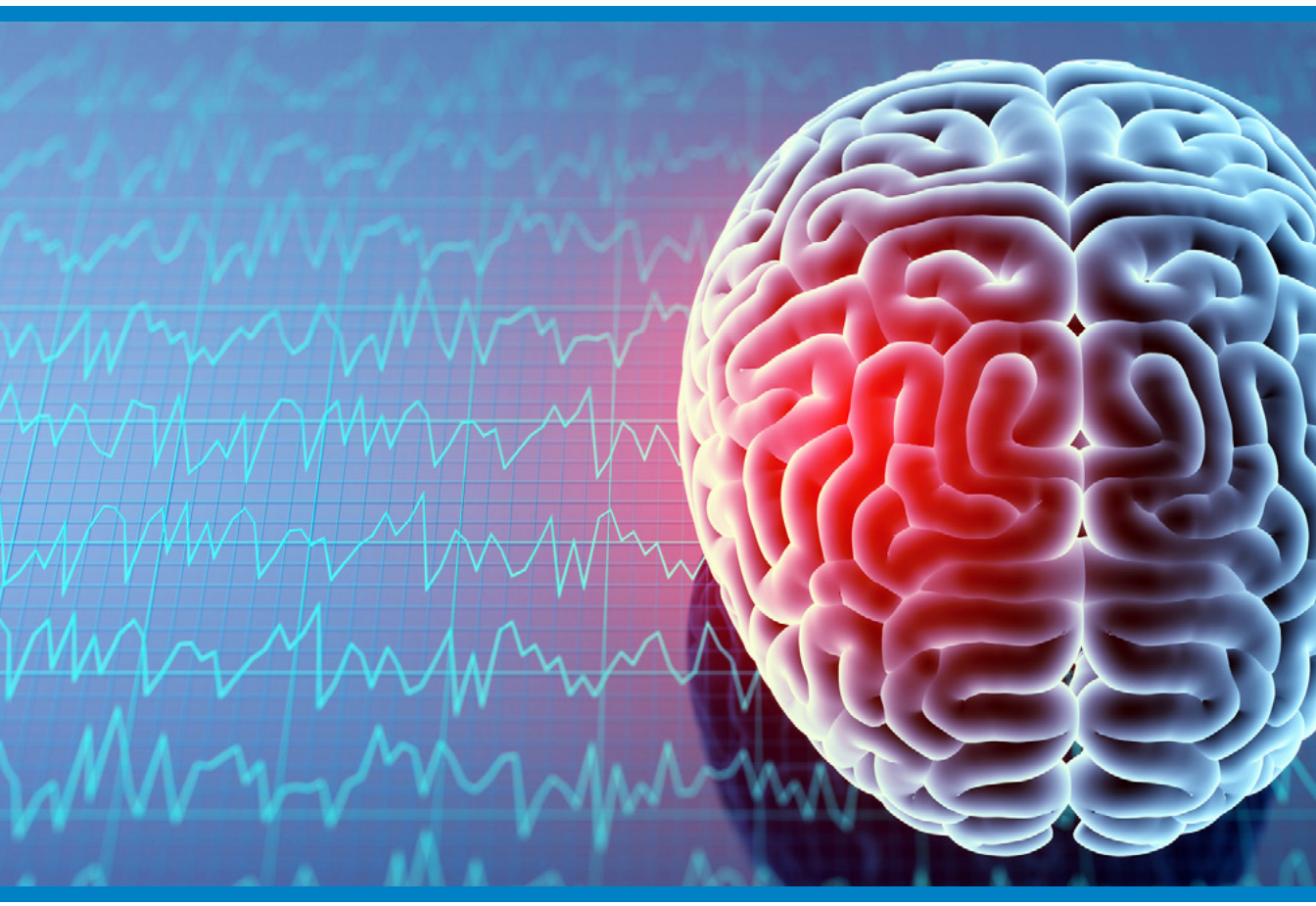
PAIN PHYSIOLOGY



PAIN PHYSIOLOGY

Key Points:

- Because pain is a multidimensional emotional and sensory experience, a patient's response can vary widely based on physiologic, psychologic, and contextual factors.
- Development of chronic pain is common after trauma, and it can lead to significant long-term functional impairment and potentially a substance use disorder.

Pain involves both sensation and response. The body first senses a noxious stimulus, localizes it to a specific region, and presents that information to the cerebral cortex. The body responds reflexively to remove itself from the painful stimulus with muscle contraction and joint flexion. The response is then extended and modified by a higher-order cognitive process involving unconscious avoidance of the painful stimulus, active cognition regarding the source of pain, and the need to approach or withdraw.

Pain begins with activation of nociceptors—most commonly found in skin and muscle tissues—that respond to heat, mechanical pressure, or chemical stimulation (Figure 1). In transduction, messages initiated by the nociceptor are propagated proximally in the nerve cell to the spinal cord, where they synapse with second-order pain neurons. These neurons transmit the message through well-defined pathways to the brain stem and ultimately the cortex.

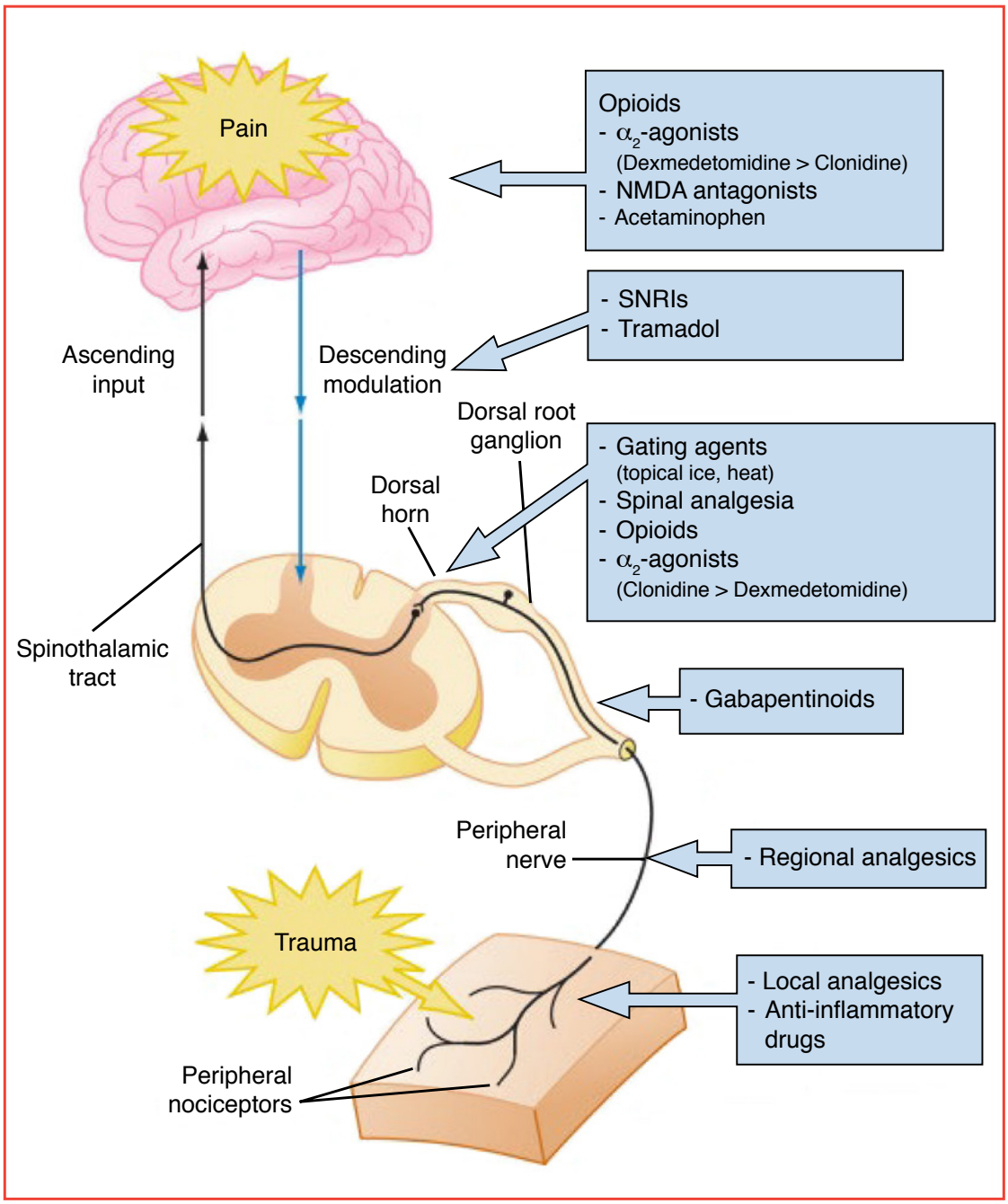
Modulation of the signal occurs through a second pathway extending from the cortex downwards to the spinal cord. Interactions within the spinal cord itself are complex and dynamic over time.

Perception is the integration of the modulated pain signal and multiple other sensory and cognitive inputs into the individual's active awareness. Even when the biochemical and anatomic stimulation is identical, a given stimulus can produce an exaggerated or diminished response based on the context in which the sensation is received (e.g., when overlaid with fear or during athletic competition or combat). Patient reported self-efficacy is a better predictor of satisfaction with pain management than the nociceptive stimulus itself.[1] Thus, the relevant context of pain is critical to effective treatment.[2]

Even when the anatomic stimulus is constant, physiologic and cognitive processing make pain perception a dynamic process. The experience of pain produces changes in the spinal cord, brain stem, and cortical architecture to either amplify or diminish the sensation. In the spinal cord, continued pain can lead to up-regulation of receptors and an amplified response to repeated stimuli. This phenomenon is thought to be important in the transition from acute pain to chronic pain.[3]

Chronic pain is continued perception of pain without an obvious or ongoing anatomic trigger. Although chronic pain often begins with an acute event, such as injury, it can become a new and self-sustaining disease in

Figure 1. Physiology of pain transmission and pain management interventions



patients with genetic, emotional, or socioeconomic predisposition. This transition is most common in patients with direct injury to nerves or with complex injuries that are slow to heal, but it can also occur after relatively trivial injuries in otherwise healthy patients. In trauma care, the transition from acute to chronic pain is a common complication, leading to significant long-term functional impairment, the potential for development of a substance use disorder (SUD), and diminished long-term health. Understanding how acute pain becomes chronic—and how to mitigate this transition—remains an active research focus.[4]

Search for evidence of chronic pain during patient follow-up visits. Carefully assess patients with continued dependence on opioid medications or obvious functional limitations despite evidence of anatomic recovery for undiagnosed injuries or other occult causes of pain, such as deep wound infection. If none are found, it is appropriate to refer the patient to a pain specialist for ongoing treatment of chronic pain syndrome, including supervised tapering from opioid medications.

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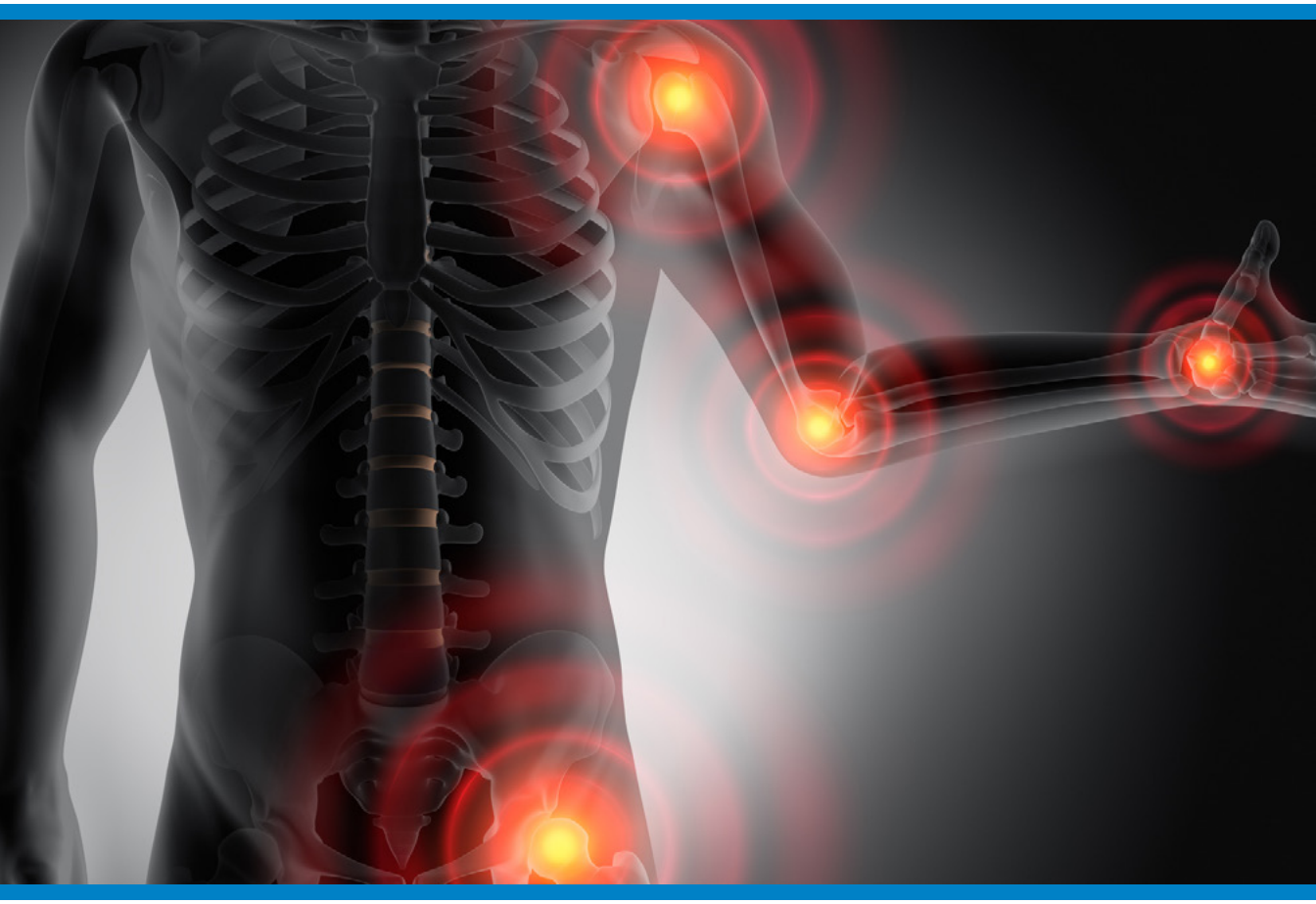
PAIN ASSESSMENT



PAIN ASSESSMENT

Key Points:

- Consider the multidimensional nature of pain when selecting a pain assessment tool.
- During pain assessment, account for the patient's cognition and ability to communicate, which may be affected by injury, extent of illness, age, and other factors.
- Reassess pain systematically, ideally using the same appropriate tool.
- Reevaluate significant changes in pain promptly to identify missed, new, or developing injuries.

Pain assessment is a complex process, and pain is difficult to fully quantify with any single assessment tool. Unidimensional scales may not accurately reflect the multidimensional nature of the patient's pain experience. The tools used to assess pain must be interpreted contextually during patient-provider interactions. Avoid changing the tool selected for the initial pain assessment unless necessary. When assessing pain, health care providers must acknowledge their biases and navigate multiple competing interests to relieve pain, prescribe responsibly, and preserve the patient-provider relationship. The goal of pain management is not "zero pain" but pain that is tolerable and allows the patient to function.

Unidimensional Assessment Tools for Cognitively Intact Adults

Unidimensional pain assessment tools take little time to administer, are easy to trend over time, and are familiar to patients and health care providers. However, these tools are subjective, require patients to be responsive, and may not completely and appropriately assess a patient's pain. Each tool can offer distinct advantages, but no single unidimensional tool is superior for pain assessment.

NUMERIC RATING SCALE (NRS)

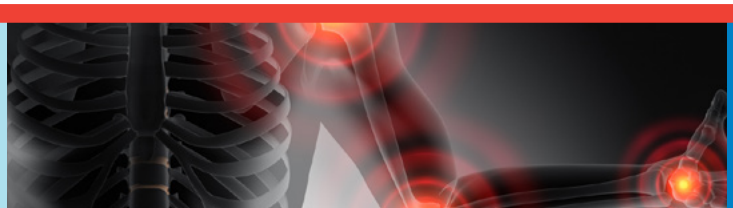
The NRS is an 11-point, patient-reported metric that scores current pain level on a scale from 0 to 10, with 0 being no pain and 10 being the worst imaginable pain. The NRS is commonly used to assess acute pain because it is familiar and simple to understand.

VISUAL ANALOG SCALE (VAS)

The VAS is a self-reported acute pain assessment tool. The patient marks their pain level on a 10 cm line with no pain written on the left and worst possible pain on the right side. For scoring, numbers from 0 to 10 can be under the line to guide the patient response, or a centimeter ruler can be used to measure the mark from the line's left side to reveal the pain score.

DEFENSE AND VETERANS PAIN RATING SCALE (DVPRS)

The DVPRS is a self-reported, graphic acute pain assessment tool. It uses the same scale as the NRS but provides more description of each level of



pain, color coding, and cartoon facial expressions (Figure 2). The tool ranges from 0 ("no pain") to 10 ("as bad as it could be, nothing else matters"). In addition, the DVPRS has supplemental questions that measure the degree to which pain interferes with usual activity, sleep, mood, and stress.[1]

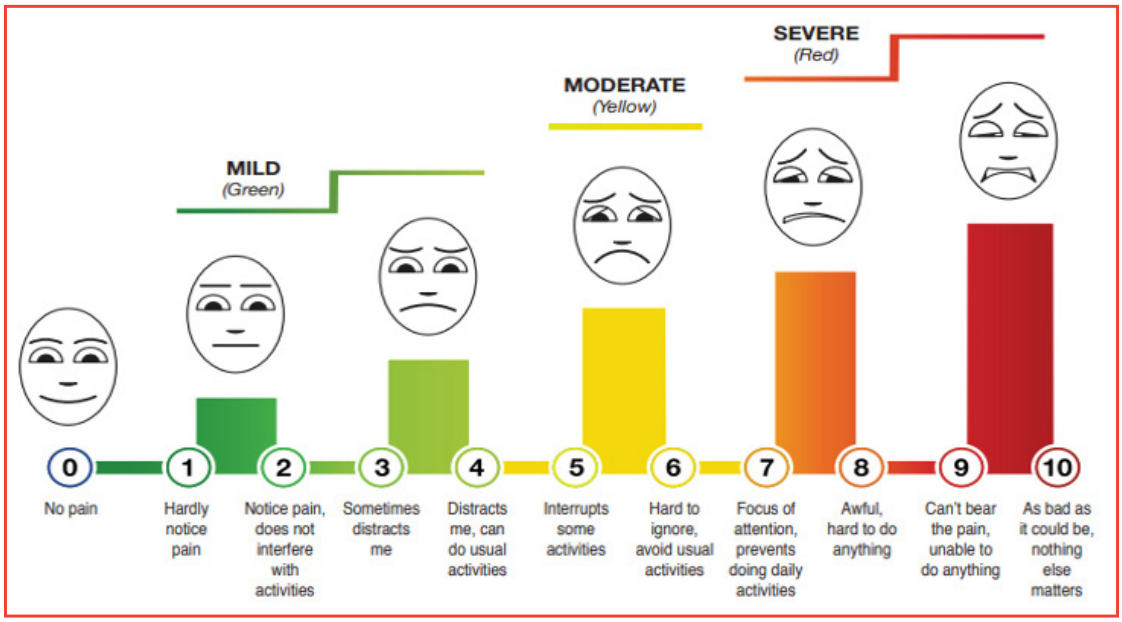
Assessment Tools for Adult Patients with Cognitive Impairment

It is more challenging to assess pain in patients who are cognitively impaired. A systematic review demonstrated that such patients are at risk for undertreatment of pain following orthopaedic trauma.[2] Assessment tools that incorporate a behavioral component for pain scoring have demonstrated validity in patients with dementia.[3] These tools were validated in a study (N=3,800) from 28 countries.[4] While behavior observations are helpful, it is important to note that behavioral scores are not equivalent to self-reported scores. These tools reveal the presence or absence of pain, but do not classify pain severity.[5] The validity of these tools continues to be studied in patients with burns, cognitive deficits, brain injuries, and in unconscious or heavily sedated patients.[6]

BEHAVIORAL PAIN SCALE (BPS)

The BPS is a three-domain tool with four scores in each domain for a possible score range of 3–12. Scores above 6 indicate an unacceptable level of pain (see Table 1). The BPS is an objective scale scored at the bedside by the nurse or other health care professional. It has high inter-rater reliability. It is widely used for sedated, mechanically ventilated, and critically ill patients.[7-9]

Figure 2. Defense and Veterans Pain Rating Scale



From: Uniformed Services University, Defense & Veterans Pain Rating Scale, Retrieved from www.dvcipm.org/clinical-resources/defense-veterans-pain-rating-scale-dvprs/, October 13, 2019. Used with permission.

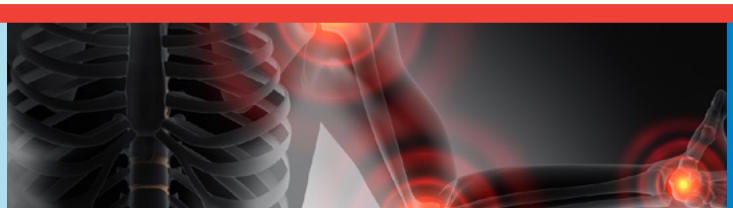


Table 1. Behavioral Pain Scale

Indicator	Score	**Description**
Facial expressions	1	Relaxed
	2	Partially tightened
	3	Fully tightened
	4	Grimacing
Upper limb movements	1	No movement
	2	Partially bent
	3	Fully bent with finger extension
	4	Permanently retracted
Compliance with mechanical ventilation	1	Tolerating movement
	2	Coughing but tolerating ventilation most of the time
	3	Fighting ventilator
	4	Unable to control ventilation
Total score	__ of 12	

Data from: Young J, Siffleet J, Nikoletti S, Shaw T. Use of a behavioural pain scale to assess pain in ventilated, unconscious and/or sedated patients. *Intensive Crit Care Nursing*. 2006;22(1):32-39; Payen JF, Bru O, Bosson JL, et al. Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Crit Care Med*. 2001;29(12):2258-2263; and Ahlers SJ, van der Veen AM, van Dijk M, Tibboel D, Knibbe, CAJ. The use of the Behavioral Pain Scale to assess pain in conscious sedated patients. *Anesth Analg*. 2010;110(1):127-133.

CRITICAL CARE PAIN OBSERVATION TOOL (CPOT)

The CPOT is an acute pain assessment tool in which health care providers objectively score patients in four domains: facial expressions, body movements, ventilator compliance/vocalization, and passive muscle tension (see Table 2). To obtain baseline values for each domain, observe the patient at rest for one minute. To assess pain, the patient is observed during any procedure known to cause discomfort, such as turning or dressing changes. Patient behavior changes from baseline values are noted. The patient is attributed the highest score for each domain during both periods. The possible score range is 0-8 with 8 indicating the most pain.[10-15]

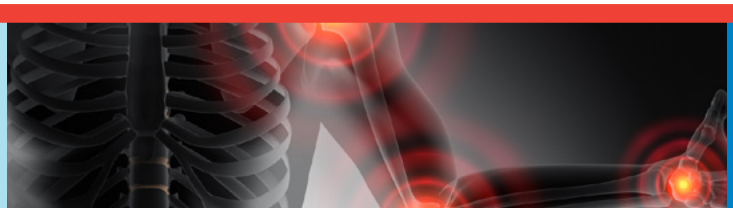


Table 2. Critical Care Pain Observation Tool

Indicator	Score	Description
Facial expressions	0	No muscle tension
	1	Frowning, brow lowering, orbit tightening, levator contraction, or any other change
	2	All previous facial movements plus eyelids tightly closed
Body movements	0	Does not move at all or normal position
	1	Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements
	2	Pulling tube, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed
Ventilator compliance (ventilated)	0	Alarms not activated, easy ventilation
	1	Coughing, alarms may be activated but stop spontaneously
Or	2	Asynchrony, alarms frequently activated
Vocalization (extubated)	0	Talking in normal tone or no sound
	1	Sighing, moaning
	2	Crying out, sobbing
Muscle tension	0	No resistance to passive movements
	1	Resistance to passive movements
	2	Strong resistance to passive movements or incapacity to complete them
Total score	__ of 8	

Data from: Gélinas C, Fillion L, Puntillo KA, Viens C, Fortier M, Viens C, Fortier M. Validation of the critical-care pain observation tool in adult patients. *Am J Crit Care*. 2006;15(4):420-427; Gélinas C, Harel F, Fillion L, Puntillo KA, Johnston CC. Sensitivity and specificity of the critical-care pain observation tool for the detection of pain in intubated adults after cardiac surgery. *J Pain Symptom Manage*. 2009;37(1):58-67; Buttes P, Keal G, Cronin SN, Socks L, Stout C. Validation of the critical-care pain observation tool in adult critically ill patients. *Dimens Crit Care Nurs*. 2014;33(2):78-81.

Functional Pain Assessment Tools

CLINICALLY ALIGNED PAIN ASSESSMENT (CAPA)

The CAPA, a relatively new tool, represents a fundamental shift from the self-reported, unidimensional pain assessment with a pain score. The CAPA provides a framework for a conversation between the patient and health care provider that focuses on pain intensity, effect of pain on function and sleep, efficacy of treatment, and progress towards relief (see Table 3). Rather than a score, this tool provides a template for a discussion with patients to assess the effect of pain on their functional status.[16]

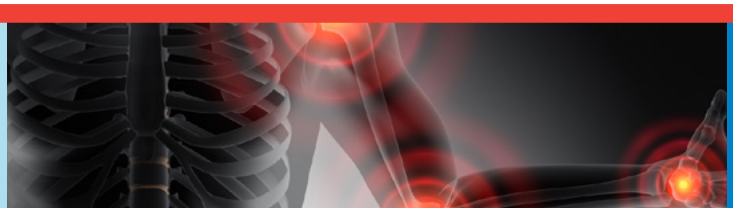


Table 3. Clinically Aligned Pain Assessment Tool

Question	Response
Comfort	• Intolerable • Tolerable with discomfort • Comfortably manageable • Negligible pain
Change in pain	• Getting worse • About the same • Getting better
Pain control	• Inadequate pain control • Effective, just about right • Would like to reduce medication
Functioning	• Can't do anything because of pain • Pain keeps me from doing most of what I need to do • Can do most things, but pain gets in the way of some • Can do everything I need to
Sleep	• Awake with pain most of night • Awake with occasional pain • Normal sleep

From: Topham D, Drew D. Quality improvement project: Replacing the numeric rating scale with a clinically aligned pain assessment (CAPA) tool. *Pain Manag Nurs.* 2017;18(6):363-371. Used with permission.

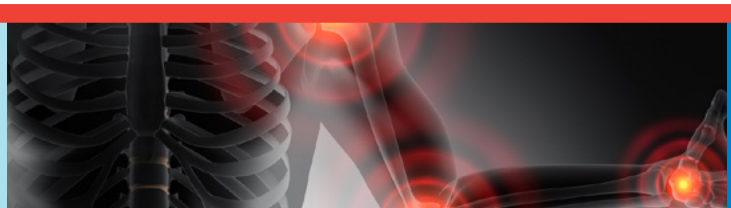
Table 4. Functional Pain Scale

FPS Score	Domains and Rating
0	No Pain
1	Tolerable and does not prevent activities
2	Tolerable and prevents some activities
3	Intolerable, but can use telephone, watch TV, or read
4	Intolerable and cannot use telephone, watch TV, or read
5	Intolerable and unable to communicate due to pain

From: Gloth FM, 3rd, Scheve AA, Stober CV, Chow S, Prosser J. The functional pain scale: Reliability, validity, and responsiveness in an elderly population. *J Am Medical Dir Assoc.* 2001;2(3):110-114. Used with permission.

FUNCTIONAL PAIN SCALE (FPS)

The FPS was developed to assess pain in an older population. This population is unique, as comorbidities like delirium and dementia can limit the applicability of traditional pain assessments. This scale uses three domains of inquiry (see Table 4). First, the patient is asked if pain is present or not. If yes, the patient is then asked to rate the pain as tolerable or intolerable. Lastly, if the pain is rated as tolerable, the health care provider determines if the pain interferes with activities of daily living.[17]



Pain Assessment in Older Adults

Self-report is the most valid and reliable indicator of pain; however, in the older adult, pain assessment may be complicated by dementia and cognitive and sensory impairments. Older adults may require more time to process questions and formulate answers, questions may need to be rephrased, and assessment tools and environments may need to be modified (e.g., increase font size, additional lighting, etc.).[7]

A hierarchical approach to assessment is recommended.

- Assess the patient who is cognitively intact using common unidimensional or functional pain scales.
- For patients with severe dementia, use the PAINAD, the Functional Pain Scale, or Doloplus-2 to assess for pain.[8,9]
- In nonverbal patients who cannot provide self-report, use tools for cognitively impaired adults (CPOT and BPS), look for pain behaviors such as guarding and grimacing, and seek input from family and caregivers.[10]

PAIN ASSESSMENT IN ADVANCED DEMENTIA (PAINAD)

The PAINAD scale is a 0–10 scale evaluating five domains scored by health care providers (see Table 5). In hospitalized geriatric patients with dementia, the PAINAD is considered more reliable and valid than a standardized unidimensional rating scale (e.g., NRS).[18,19]

DOLOPLUS-2

Doloplus-2 is a behavioral pain assessment for adults who are cognitively impaired. It was adapted from the Doloplus, a tool developed for assessment of neoplastic pain in children. Behavioral manifestations of pain are measured by the Doloplus-2 in three domains: somatic, psychomotor and psychosocial. The 10-item assessment was studied in patients across the spectrum of cognitive impairment severity. Although evidence supports its use, the optimal clinical scenario for its application and its precise utility in pain management is not yet proven.[20] See Appendix A for the Doloplus-2.

Pediatric Pain Assessment Tools

Children have unique age and developmental aspects as they recognize, interpret, and respond to pain.[3] Infants and young children are unable to communicate their pain experience, making recognition and assessment of pain difficult.[4] Pain presence is suggested in preverbal children by excessive crying, irritability, poor feeding, position and movement of the arms and legs, sleep disturbance, and altered facial expression. Pain assessment tools generally focus on physiological and behavioral reactions and may therefore reflect stress not otherwise associated with pain. The complex health care environment in itself may be anxiety-provoking. A recent, multicenter study of 456 children aged six through seventeen years found that the visual analog scale

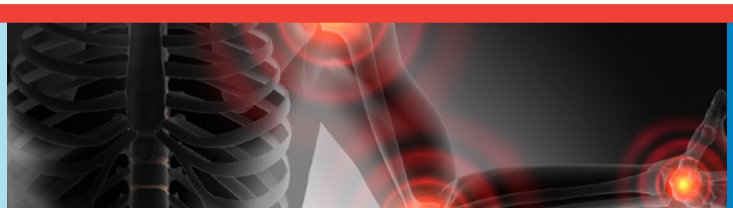


Table 5. Pain Assessment in Advanced Dementia (PAINAD) Scale

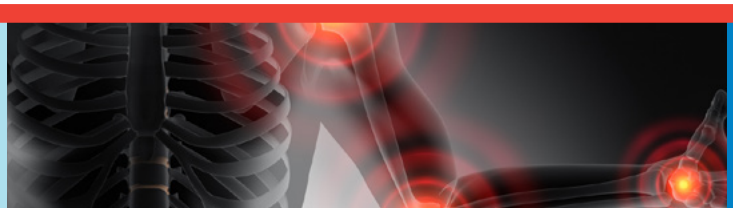
Indicator	Score	Description
Breathing	0	Normal
	1	Occasional labored breathing Short period of hyperventilation
	2	Noisy labored breathing Long period of hyperventilation Cheyne-Stokes respirations
Negative vocalization	0	None
	1	Occasional moan or groan Low-level negative/disapproving speech
	2	Repeated troubled calling out Loud moaning or groaning Crying
Facial expression	0	Smiling/inexpressive
	1	Sad/frightened/frowning
	2	Facial grimacing
Body language	0	Relaxed
	1	Tense Distressed pacing or fidgeting
	2	Rigid Fists clenched or knees pulled up Pulling/pushing away Striking out
Consolability	0	No need to console
	1	Distracted/reassured by voice or touch
	2	Unable to console, distract, or reassure
Total Score	__ of 10	

From: Warden V, Hurley AC, Volicer L. Development and psychometric evaluation of the pain assessment in advanced dementia (PAINAD) scale. *J Am Med Dir Assoc*. 2003;4(1):9-15. Used with permission.

(VAS), Color Analog Scale (CAS), and Faces Pain Scale-Revised (FPS-R) were reliable for assessment of acute pain in children in the emergency department.[10] Children with chronic illness may have heightened fear and anxiety to perceived painful experiences. Thus, it is critical to use an age and developmentally appropriate pain assessment tool.

FLACC-REVISED (FACES, LEGS, ACTIVITY, CRY, CONSOLABILITY) BEHAVIORAL PAIN ASSESSMENT

The FLACC-Revised pain assessment tool is valid for assessing pain in infants, toddlers, and patients with a cognitive disability or who are unable to self-report because of surgery, trauma, cancer, or other disease processes.[5] The FLACC-Revised pain scale quantifies



five pain domains including facial expression, leg activity, general behavior, crying, and consolability. Each domain is scored between 0 and 2 for a total score between 0 and 10, with 0 being the least amount of pain and 10 being the most.[21,22]

FACES PAIN SCALE

Revised in 2001 to the FPS-R, the Biere Faces Pain Scale contains six oval faces ranging from a neutral face (no pain, score of 0) to an extremely uncomfortable, grimacing face with no tears (most pain, score of 10). This tool is validated for patients over 3 years of age, and it was modified from the Wong-Baker Faces scale. The patient is shown the faces and is asked to identify the face that best describes their current pain intensity.[23]

COLOR ANALOG SCALE

The Color Analog Scale (CAS) requires children to mark their current pain on a 10 cm gradient from "no pain" (white/pink) to "most pain" (red/brown). The distance between "no pain" at the bottom of the gradient and the mark from the child is measured in centimeters and represents a 0–10 unidimensional scale. The CAS has been validated for children at least 5 years of age.[24]

PAIN ASSESSMENT TOOLS FOR CHILDREN WITH COGNITIVE IMPAIRMENT

Children with cognitive impairment may have communication difficulty and atypical pain responses that require special considerations. Validated tools to assess pain in children with cognitive impairment include the Non-Communicating Children's Pain Checklist–Postoperative Version (NCCPC-PV) and the Echelle Douleur Enfant San Salvadour (DESS).[11]

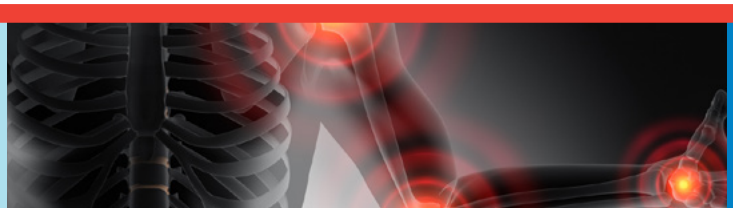
Physiologic Measures of Pain

Validated physiologic measures continue to elude health care providers, even though this is thought to be a promising measure of pain in patients who cannot self-report.

- Vital signs are poor predictors of pain—do not use vital sign changes as the only assessment for pain.[25-27] A change in vital signs may be an indication to conduct further pain assessments.
- The use of pupillometry and/or modified electroencephalography (e.g., bispectral index [BIS], Narcotrend, cerebral state index, and E-Entropy) in ICU patients to guide the administration of analgesics and sedatives does not provide reliable results, and therefore no recommendations are made regarding their use.[28,29]

Pain Reassessment

The Joint Commission standards state that a hospital must have "defined criteria to screen, assess, and reassess pain that are consistent with the patient's age, condition, and ability to understand."[30] A trauma center's policies



and procedures must reflect these standards, to include at a minimum, the interval at which a patient is assessed and reassessed for pain, and if patients are to be awakened for pain assessments. After a pain intervention is completed, reassess patients for both pain control and adverse reactions to the intervention at an appropriate interval based on the anticipated effect (e.g., drug onset and peak effect). When a significant change in worsening pain level is reported, promptly reevaluate the patient for possible evolving or missed injury.

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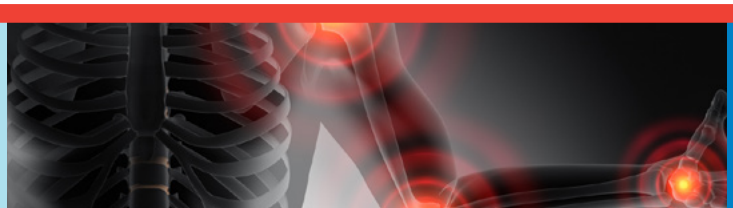

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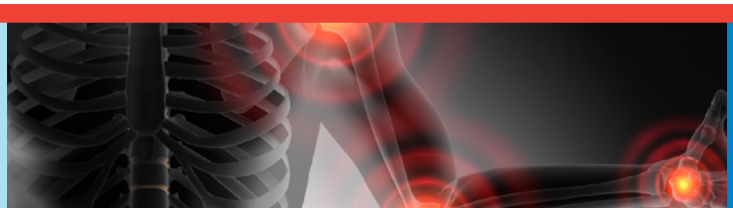


NONPHARMACOLOGIC PAIN MANAGEMENT

NONPHARMACOLOGIC PAIN MANAGEMENT

Key Points:

- Nonpharmacologic pain management strategies are recommended as adjuncts for pain and anxiety management in trauma to minimize opioid usage and chronic pain development.
- While the risk-benefit supports wide use of nonpharmacologic pain management, the evidence base is stronger for cognitive rather than physical strategies.

Although the evidence supporting the use of many nonpharmacologic pain management strategies in the setting of acute injury is not expansive, the interventions themselves are generally low-risk. Many nonpharmacologic techniques require little specialized training, and some techniques are even used subconsciously by providers during patient care. It is recommended that these strategies be considered as adjuncts for pain and anxiety management in trauma across the entire age spectrum from children to adults, particularly in an effort to minimize opioid usage and chronic pain development. Tailor the specific treatments chosen to the needs of patients and resources available in each facility. See Table 6 for an overview of nonpharmacologic pain management strategies, evidence of effectiveness, experience needed to implement, and cost.

A clear role exists for nonpharmacologic pain management in children. Multiple small, single center studies reported beneficial effects of music therapy, virtual reality environments, hypnosis, and other techniques to reduce pain and distress.[1] However, as in adults, minimal high-quality evidence exists.

Cognitive Strategies

ANIMAL-ASSISTED THERAPY

Animal-assisted (pet) therapy is the use of animals in the inpatient and outpatient setting for the purpose of improving mood and distracting patients from acute anxiety and pain. This therapy can be performed through simple in-hospital pet visitations (animal-assisted activities) or through planned visits with clearly defined goals and measured results (animal-assisted interventions) using a trained pet therapist.[2] All animals require training, and Centers for Disease Control and Prevention (CDC) guidelines relating to infection control must be followed. A recent meta-analysis of pet therapy to reduce pain and anxiety concluded that benefits existed for children and adults, but better controlled studies are necessary.[3]

COGNITIVE BEHAVIORAL THERAPY (CBT)

CBTs aim to improve a patient's control over their perception of pain. Examples include setting expectations before surgery, teaching relaxation techniques, using guided mental imagery for diversion, coaching family members, and using active distraction through conversation. Randomized

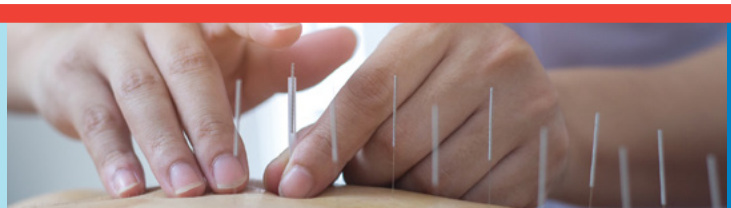


Table 6. Overview of Nonpharmacologic Pain Management

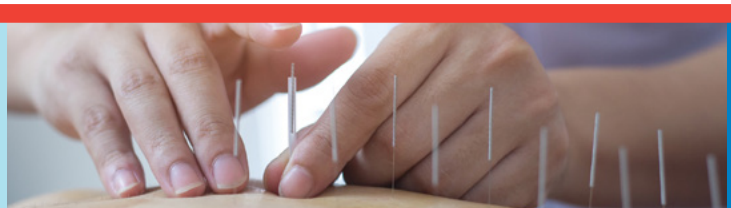
Therapy	Evidence Base in Trauma/Burn Care	Expertise Required	Associated Cost
Cognitive Strategies			
Animal-assisted therapy	Low	Moderate	Moderate
Cognitive behavioral therapy	Moderate[A,B]	Moderate	Low
Hypnosis	Moderate[C,D]	High	Moderate
Mindfulness	Low[B,C]	Moderate	Low
Music therapy	Moderate[C]	Low	Low
Virtual reality	High[D]	Low	High
Physical Strategies			
Acupuncture	Moderate[D,E]	High	High
Aromatherapy	Moderate[D,E]	Low	Low
Iontophoresis	Moderate[E]	High	High
Immobilization	Moderate[E]	Low	Low
Massage therapy	Moderate[A,D]	Moderate	Low
Temperature therapy (cold)	Low	Low	Low
Temperature therapy (heat)	Moderate[E]	Low	Low
Transcutaneous electrical nerve stimulation (TENS)	High[E]	Moderate	High
Ultrasound	Moderate[F]	High	High

Key: [A]Spinal cord injury, [B]Chronic pain, [C]Extremity/orthopaedic trauma, [D]Burn, [E]Perioperative/acute pain, [F]Muscle/tendon injury.

studies demonstrated reductions in post-traumatic stress disorder (PTSD) symptoms in trauma victims following organized sessions of CBT,[4-6] and CBT sessions have been shown to significantly reduce pain and pain-associated disability for spinal cord injury patients.[7]

Multiple preoperative interventions can reduce the amount of analgesia required after surgical procedures. Preoperative teaching regarding pain, expectation setting, and the analgesia plan reduces anxiety, and thereby, the need for postoperative medication.

Patients are better able to handle postoperative pain with their own psychological resources when prepared. A single 15-minute teaching intervention to hospitalized patients by a trained social worker reduces anxiety, pain severity, and desire for opioids.[8] Likewise, approximately a third of patients taught meditation and mindfulness techniques obtained pain relief equivalent to 5 mg of oxycodone.[8] Trauma centers are encouraged to integrate these techniques as part of any multimodal approach to management of pain.



HYPNOSIS

Hypnosis is a cognitive technique designed to heighten an individual's responsiveness to suggestion in an effort to alter behavior, feelings, thoughts, or perceptions. Hypnosis is used extensively for chronic pain syndromes, and evidence exists to support its use in acute injury.[9-15] Several randomized controlled trials (RCTs) demonstrated that preoperative and perioperative hypnotherapy provided a small-to-medium effect on pain and emotional distress for some patients.[9,10] RCTs have documented a reduction in pain and anxiety with use of hypnosis as an adjunct for both adult and pediatric burn patients.[12,13] Lower-quality data suggests similar effects of successive hypnosis sessions in patients with multiple long bone fractures.[15]

MINDFULNESS

Mindfulness trains an individual to observe painful situations as they arise and to consciously let go of the anxiety and struggle associated with the painful event. The effectiveness of this technique is best demonstrated with chronic pain syndromes.[16] However, several studies demonstrated mindfulness interventions can reduce perceived pain, pain intensity, and complicating factors (e.g., anxiety, anger, and depression) in the acute setting.[8,17]

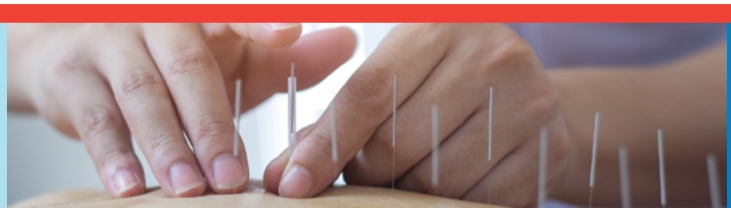
MUSIC THERAPY

Music therapy is a passive distraction technique that is self-explanatory, low-risk, and requires minimal-to-no caregiver expertise. One observational pre/post study suggests music therapy can reduce pain and is highly acceptable to adult orthopaedic trauma patients.[18] Another study of hospitalized patients with acute pain demonstrated reductions in pain perception and mood scores after listening to the music of their choice.[19] A meta-analysis of studies looking at the specific characteristics of music used in reducing pain identified a benefit for music without lyrics.[20]

Two prospective, single center trials demonstrated that music therapy may have a positive impact on procedural pain in children related to IV line placement in the emergency department.[21-22] However a single center, randomized, prospective study of 135 children with a median age of 22.6 months suggested music therapy was not effective in reducing pain and discomfort associated with burn wound care.[23] The authors did show a significant reduction in pain in a subset of children older than 5 years and speculated that music therapy may be more effective in older children.

VIRTUAL REALITY

At present, the majority of studies evaluating virtual reality (VR) are from the burn population, but many suggest improvement in pain control, improved performance in physical therapy and high patient satisfaction with use, especially among young children and adolescents.[24-27] As VR technology improves and becomes more accessible, additional studies in the setting of acute pain management for patients without burns are expected.



Physical Strategies

ACUPUNCTURE

Acupuncture uses the auricle as a homunculus, where specific areas of the auricle corresponding to different body parts are stimulated to relieve pain in the affected body part. While acupuncture has been widely studied for chronic pain syndromes, evidence supporting use in the treatment of acute injury pain is limited. One RCT demonstrated significant reductions in pain at time of treatment and 24 hours post-treatment when acupuncture was used to treat acute pain in an emergency department setting.[28] A nonrandomized and observational large single institution series of 1,008 patients also reported improvements in pain scores following acupuncture when used for pain management in patients with partial thickness burns.[29]

AROMATHERAPY

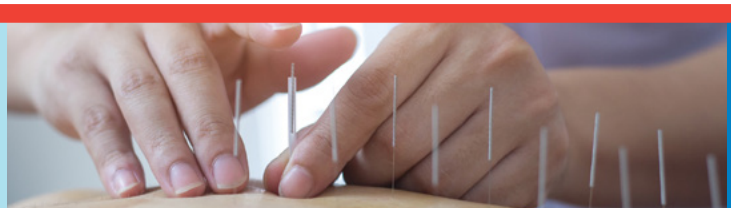
Aromatherapy using essential oils contributes to pain relief and relaxation by transcutaneous absorption, through the olfactory system, or both. It is frequently used with massage therapy, but it can be used as an isolated therapy. A meta-analysis of four RCTs examining the use of aromatherapy in burn patients showed some benefit in reduction of baseline pain and anxiety associated with dressing changes.[30] Another meta-analysis of nine RCTs showed inconsistent results attributed to the use of aromatherapy in the immediate postoperative period (five studies demonstrated a benefit, and four studies demonstrated no effect).[31]

IONTOPHORESIS

Iontophoresis is a physiotherapy technique in which medications are delivered to the soft tissues with a low-voltage electrical current. Local anesthetics or corticosteroids are applied to one of two electrodes placed on the skin, and the medication penetrates into the soft tissues through the electrical gradient created by the electrical current application. A recent meta-analysis of 10 studies concluded that iontophoresis is effective in the treatment of injury-related pain, but the quality of evidence was low because several studies had flaws in the research design.[32]

IMMOBILIZATION

Immobilization is used in extremity and pelvic trauma to stabilize the affected body part prior to surgical repair. In addition to its widely accepted beneficial effects on hemorrhage reduction and fracture healing, immobilization also has a beneficial effect on pain management during the acute injury period. However, acute analgesic benefit must be balanced against faster functional recovery with early mobilization.[33] A single RCT evaluating the use of more versus less immobilization in the management of supracondylar fractures demonstrated a significant analgesic benefit in the group with more immobilization.[34,35] Similarly, an additional RCT demonstrated significant pain reduction in casted versus splinted patients with buckle fractures of the distal radius.[36] Immobilization of the affected extremity is strongly recommended as an adjunct to pain management in adult and pediatric patients with acute pelvic or extremity trauma.



MASSAGE THERAPY

Massage therapy can affect pain relief by physical and psychological mechanisms. It stimulates blood flow and relieves muscle spasm, and it also promotes generalized relaxation and feelings of well-being that may decrease perceptions of pain. Massage therapy studies are most commonly focused on oncology and palliative populations. However, massage therapy was demonstrated to reduce pain and anxiety in burn and spinal cord injury patients.[37,38]

TEMPERATURE THERAPY

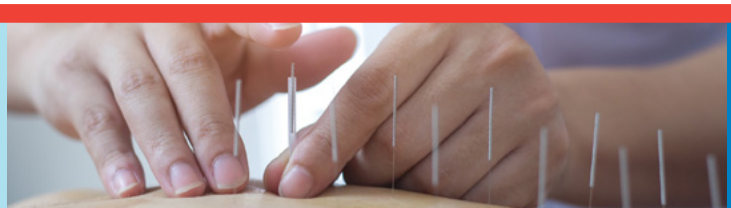
Cold therapy (cryotherapy) is the use of external cooling to reduce internal tissue temperature, which in turn decreases vascular permeability and tissue edema, local inflammatory mediators, metabolic demand, and tissue hypoxia. Ice packs, gel packs, and cold-water immersion are widely used as pain management adjuncts in orthopaedic and soft tissue injuries.[39-41] RCTs consistently show cryotherapy produces analgesia and reduces opioid requirements after orthopaedic procedures, but no direct evidence exists in the trauma population.[42-50] Superficial nerve palsies with cryotherapy can be reduced by providing insulation between the skin and cold source.[51,52]

Heat therapy, the use of external warming to relieve the discomfort associated with injury, increases blood flow (including oxygen and nutrient delivery), decreases joint stiffness, and promotes muscle relaxation. It is most commonly used after the acute injury period. A recent meta-analysis of temperature therapy in the treatment of traumatic pain found no clear benefit for the use of cold therapy following injury, but suggested pain reduction when short-term heat was used during the rehabilitation phase of musculoskeletal injury.[53] Heat is usually applied after skeletal fixation when rehabilitation begins.

While temperature therapies can be beneficial, they have the potential for localized thermal injuries. Use them with caution in infants, pregnant women, older adults, patients who have undergone radiation therapy, and patients with impaired sensation or peripheral neuropathy.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION

Transcutaneous electrical nerve stimulation (TENS) is the use of low-voltage electrical currents over the skin from a portable device at the bedside. Reduction of pain is thought to be achieved through the stimulation of large diameter peripheral afferent nerve fibers, leading to the secondary activation of opioid receptors.[54] The TENS current can be deployed with varying intensities and frequencies, which are not standardized across clinical studies. Most TENS studies focus on reductions in postoperative pain and opioid usage, rather than pain relief following injury. A meta-analysis of the recent RCTs concluded that TENS around the postoperative wound leads to improved pain control and decreased analgesic use, particularly when a strong, subnoxious current is used.[55] Recent pain management guidelines



published by the Orthopaedic Trauma Association strongly recommend the use of TENS as an adjunctive therapy for pain relief following orthopaedic injury and orthopaedic surgery.[56] Contraindications to the use of TENS therapy include skin disruption at the site of application, indwelling pacemakers or defibrillators, and lymphedema.

ULTRASOUND

Therapeutic ultrasound uses low-intensity sound waves to generate heat within the soft tissues. It has been used by physiotherapists for decades to treat a variety of conditions related to injury, including tendinitis, chronic joint swelling, and muscle spasm. This therapy improves blood flow and reduces muscle spasm, potentially accelerating the healing of muscle and tendon injuries.[57] It is frequently used as a pain management adjunct in these cases. Although therapeutic ultrasound creates heat within the tissues, it is typically low risk and not painful at the dose intensities used for therapy.

High-intensity focused ultrasound (HIFU) uses higher intensity sound waves distributed to a very focal target. It is thought to work via local neuromodulatory effects, including demyelination of small afferent sensory nerves in the target area. It has demonstrated analgesic effects in studies of patients with arthropathies, disc disease, and cancer pain from both primary tumors and bony metastases.[58] Evidence supporting the use of HIFU in the acute trauma setting is lacking.

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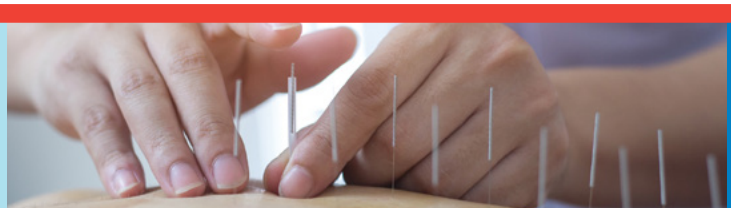

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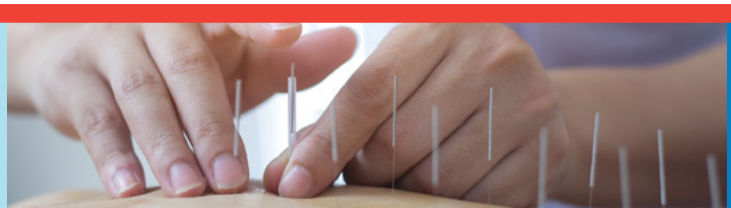

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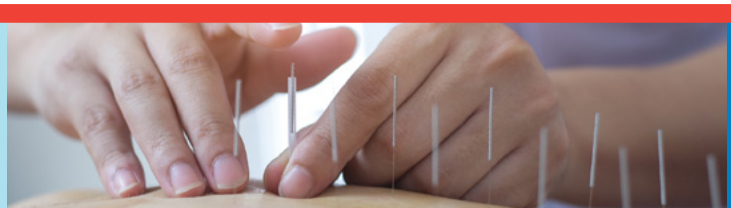

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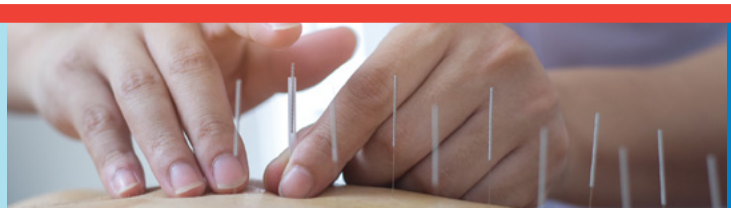

PHARMACOLOGIC ANALGESIA

PHARMACOLOGIC ANALGESIA

Key Points:

- Include acetaminophen (APAP) and nonsteroidal anti-inflammatory drugs (NSAIDs) in pain management unless contraindicated.
- Opioids are the standard comparison for effectiveness of pharmacologic analgesics to treat acute, severe nociceptive pain; however, their use may be limited by central nervous system and respiratory depression, as well as ileus and tolerance.
- Overreliance on opioids, specifically as monotherapy for analgesia, may contribute to opioid dependence. Other factors that increase risk of chronic opioid use after trauma include prior opioid use, chronic back pain, depression, and prolonged hospital stay.
- Assess patients daily to determine the types of pain experienced (nociceptive, neuropathic, visceral, etc.), as well as for other systemic injuries and/or comorbidities that may necessitate caution when prescribing analgesics. Optimize the medication regimen accordingly.

While nonpharmacologic pain management is recommended based on the risk versus benefit profile, most patients will require pharmacologic analgesia after traumatic injury. Opioids are effective analgesics that were considered the mainstay of treatment. However, the opioid crisis in the United States (U.S.) has increased scrutiny of opioid use and highlighted the potential usefulness of multimodal analgesia (MMA) strategies. See Table 7 for a summary of selected analgesics.

Acetaminophen

Acetaminophen (APAP) is a commonly used analgesic and antipyretic, although its exact mechanism of action for pain management remains unknown. APAP offers several advantages, including numerous routes of administration, ease of access, and relatively few adverse effects. The addition of APAP to traditional opioid therapy consistently demonstrates decreased morphine requirements.[1,2] Scheduled dosing is ideal. Intravenous APAP is commonly used in several countries as the only postoperative analgesic; however, many U.S. hospitals do not include it in their inpatient formularies because of the drug's high cost and similar analgesic effects between scheduled intravenous and oral therapy.[3] Intravenous APAP is generally well-tolerated and effective in most patients, but hypotension has been reported in some patients.[4] Recognize that the liquid oral formulation of APAP contains sorbitol and can cause diarrhea in some patients. Avoid APAP in patients with acute liver failure, and use reduced doses in older adults and patients with chronic liver disease.

Table 7. Selected Analgesics and Considerations for Use

Medication	Dosing			Precautions (P), Contraindications (CI), and Considerations[A]
	Maintenance Dose	Routes of Administration	Maximum Suggested Dose/ Duration[A]	
Acetaminophen	1,000 mg q6h	PO, PR, IV	4,000 mg/day (2,000-3,000 mg/ day in older adults)	• Liver dysfunction (P) • Cardiac dysfunction (P)
NSAIDs				
Ibuprofen	400 mg q6h	PO	2,400 mg/day	• Cardiac history (CI) • GI bleeding (CI) • Fracture (P) • Renal dysfunction (P) • Single dose ibuprofen > 400 mg or ketorolac >10 mg not recommended • COX-2 selective NSAIDs reduce risk of major and upper gastrointestinal bleeding vs. nonselective
Ketorolac	10 mg q6h	PO, IV	40 mg/day for no more than 5 days	
Celecoxib	100 mg q12h	PO	400 mg/day	
Skeletal Muscle Relaxants (SMR)				
Cyclobenzaprine	5 mg q8h	PO	30 mg/day	• Older Adult (P) • Sedating, especially with other CNS depressants • IV methocarbamol should be limited to < 3 days • Tizanidine may cause significant hypotension
Methocarbamol	1,000 mg q8h	PO, IV	4,000 mg/day	
Tizanidine	2 mg q6-8h	PO	32 mg/day	
Diazepam	2 mg q6h	PO, IV	40 mg/day	
Antiepileptics				
Gabapentin	300 mg q8h	PO	1,800 mg/day	• Older adult (P) • Renal dysfunction (P) • Consider for neuropathic pain • Sedating, especially with other CNS depressants • Require taper if on longer than 7 days
Pregabalin	150 mg q12h	PO	600 mg/day	
Serotonin/Norepinephrine Reuptake Inhibitors				
Duloxetine	30-60 mg/day	PO	60 mg/day	• Renal/hepatic dysfunction (P) • Consider for neuropathic pain • Sedating, especially with other CNS depressants • Require taper if on longer than 7 days
Venlafaxine	37.5-75 mg/day	PO	225 mg/day	

Table 7. Selected Analgesics and Considerations for Use (Continued)

Medication	Dosing			Precautions (P), Contraindications (CI), and Considerations[A]
	Maintenance Dose	Routes of Administration	Maximum Suggested Dose/ Duration[A]	
N-methyl D-aspartate (NMDA) Antagonists				
Ketamine	0.3 mg/kg (bolus) 0.1 mg/kg/ hr (infusion)	IV, IM, IN	0.5 mg/kg/ dose (bolus) 1 mg/kg/hr	• Acute psychosis, cerebrovascular accident (CVA), cardiac decompensation (CI) • Dose based on ideal body weight if obese • Dependence potential • Monitor for emergence reactions
Magnesium	30–50 mg/kg	IV	Limited evidence to guide	• Heart block or myocardial damage (CI) • Renal dysfunction (P) • Bolus dose associated with hypotension, flushing
α_2-receptor agonists				
Clonidine	0.1 mg q8h	PO	2 mg/day	• Hemodynamic instability (P) • Hypotension and bradycardia common with dexmedetomidine bolus, development of hypotension, and bradycardia with infusion may limit its use • Sedating • Require taper if on longer than 7 days
Dexmedetomidine	0.4 mcg/kg/ hr (infusion) ±1 mcg/ kg (bolus)	IV	1.4 mcg/kg/hr	
Opioids				
Fentanyl	IV: 25-50 mcg q30-60min CI: 50 mcg/hr	IV	200 mcg/hr	• All opioids confer risk of addiction and life-threatening respiratory depression • Extended-release preparations are not intended for acute pain • Fentanyl may accumulate in lipid stores with prolonged use
Hydromorphone	PO: 2 mg q4h IV: 0.4 mg q3h CI: 0.5 mg/hr	PO, IV	PO: 10 mg/dose IV: 1 mg/dose CI: 3 mg/hr	
Morphine	IV: 2 mg q3h	PO, IV	10 mg/dose	
Oxycodone	5 mg q4h	PO	20 mg/dose	
Tramadol	50 mg q4h	PO	400 mg/day	

Table 7. Selected Analgesics and Considerations for Use (Continued)

Medication	Dosing			Precautions (P), Contraindications (CI), and Considerations[A]
	Maintenance Dose	Routes of Administration	Maximum Suggested Dose/ Duration[A]	
Local Anesthetics				
Lidocaine	1.5 mg/kg (bolus) 5% patch q24h	IV, topical	200 mg/dose (IV) 3 patches/day	• Heart block (CI, intravenous product) • Monitor for local anesthetic systemic toxicity with IV product • Limited evidence for topical formulations

[A]The information listed in this table is intended to represent general dosing recommendations and adverse effect concerns and is not intended to be an extensive listing of all possible precautions, contraindications, and considerations.

Data from: Erstad BL. Attempts to limit opioid prescribing in critically ill patients: not so easy, not so fast. *Ann Pharmacother*. 2019; 53(7): 716-725. doi: 10.1177/1060028018824724; O'Connor AB, Dworkin RH. Treatment of neuropathic pain: an overview of recent guidelines. *Am J Med*. 2009; 122(10 Suppl), S22–S32. doi: 10.1016/j.amjmed.2009.04.007; See S, Ginzburg R. Skeletal muscle relaxants. *Pharmacotherapy* 2008;28(2):207-213. doi: 10.1592/phco.28.2.207.; Oyler DR, et al. Nonopioid management of acute pain associated with trauma: focus on pharmacologic options. *J Trauma Acute Care Surg* 2015;79(3):475-483.[48-51]

N-methyl-D-aspartate (NMDA) Antagonists

Ketamine, a phencyclidine derivative that acts as an N-Methyl-d-aspartate (NMDA) antagonist, is emerging as a promising agent in the setting of acute trauma when using analgesic doses. It offers analgesia without compromising respiratory status or inducing hypotension.[5-7] Subdissociative- and subanesthetic-dose ketamine, also called analgesic-dose ketamine, is generally accepted as any dose under 0.3–0.5 mg/kg (throughout this guideline, we use the term analgesic-dose ketamine). Recent consensus guidelines from the American Society of Regional Anesthesia and Pain Medicine, the American Academy of Pain Medicine, and the American Society of Anesthesiologists, recommend analgesic-dose IV ketamine as a perioperative adjunct in patients anticipated to experience moderate-to-severe postoperative pain, patients with opioid tolerance, and patients with obstructive sleep apnea.[8]

Use analgesic-dose ketamine with caution in patients with a significant cardiovascular history and/or in populations in whom acute transient increases in blood pressure may be harmful or dangerous. Historically, a concern existed for increased intracranial pressure (ICP) following the use of ketamine in patients with traumatic brain injury (TBI); however, recent reviews demonstrate safety when using ketamine for this population.[9]

Magnesium, at higher doses, decreases opioid requirements in the perioperative setting through NMDA antagonism; however, this effect is

not yet described in the acute trauma setting.[10] Methadone, in addition to mu opioid agonist effects, acts as an NMDA antagonist and may have opioid sensitizing/sparing effects when used in tolerant patients or at high doses.

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)

NSAIDs work by inhibiting cyclooxygenase enzymes (COX-1 and 2), thereby inhibiting prostaglandin synthesis. Multiple studies established NSAIDs as equally effective to opioids for acute traumatic pain in adults and children.[11-13] When used alone or in combination with opioids, NSAIDs can greatly decrease opioid requirements.[14-16] NSAIDs are widely available with numerous cost-effective routes of administration.

NSAIDs carry notable risks of gastrointestinal bleeding, acute kidney injury, and cardiovascular events. Most risks are associated with long-term use, and risks may vary by COX selectivity, even between drugs in the same class. Although the primary risk of NSAID therapy is gastrointestinal bleeding, all NSAIDs have antiplatelet activity contributing to an increased risk of bleeding at any site. Antiplatelet effects occur mainly through COX-1 inhibition; therefore, selective COX-2 NSAIDs (e.g., celecoxib) have decreased risk of inhibiting platelet aggregation. While no high-quality evidence exists regarding the use of NSAIDs in the presence of TBI or intracranial hemorrhage, most practitioners avoid the use of both COX-1 and COX-2 inhibitors in this setting.[17]

NSAIDs are sometimes held preoperatively depending upon type of case and surgeon preference. Prophylactic use of preoperative ketorolac is contraindicated due to bleeding risk. Weigh the risk and impact of bleeding against the benefit of analgesia on a case-by-case basis. Use NSAIDs cautiously in patients after colorectal resection because limited evidence suggests an increased risk of anastomotic failure.[18]

Many providers are concerned that NSAID use after trauma may impair wound and fracture healing. Recent literature demonstrates that short-term, early NSAID use does not increase risk of fracture nonunion.[19-23] A similar dose and duration-dependent effect is seen in spinal fusion, with early short (less than 48 hours) administration not having a significant deleterious effect on bony fusion, but aiding in early mobilization and discharge.[24,25] Avoid longer term (2 weeks or longer) use of NSAIDs in the setting of fracture.

Use of NSAIDs, particularly at scheduled intervals, may contribute to or complicate the differential diagnosis of acute kidney injury, which develops in at least 30% of patients in ICU settings.[26] Additionally, NSAIDs require caution when used in coagulopathic patients or those otherwise at risk for stress-related mucosal bleeding.

Opioids

Exogenous opioids modulate pain signaling in ascending and descending pathways of the brain and spinal cord

and at the supraspinal level in a manner similar to endogenous opioid peptide ligands.[27] Additionally, exogenous opioids activate the reward system of the brain within the ventral tegmental area, nucleus accumbens, and frontal cortex; therefore, repeated use increases risk of dependence and addiction.

Due to the wide variety of dosage forms, established efficacy, and low cost, opioids remain the standard of effectiveness comparison for the treatment of acute, severe nociceptive pain. Opioid use is also associated with dose-dependent respiratory and central nervous system (CNS) depression. Avoid opioid use concomitantly with other CNS depressants (e.g., benzodiazepines, skeletal muscle relaxants, gabapentinoids, etc.) outside of specific clinical scenarios in highly monitored settings (e.g., management of pain and alcohol withdrawal syndrome in the ICU). Opioid use delays return of bowel function and increases risk of ileus; therefore, a bowel regimen containing a stimulant laxative is recommended for all patients receiving opioids unless contraindicated. Additionally, chronic opioid use after surgery remains a significant concern.[28-30] Several tools to assess for risk of new persistent opioid use are discussed in the section titled Pain Management at Hospital Discharge.

Prior to initiating opioid therapy, screen patients for factors that may increase risk of overdose or substance use disorder (SUD) development, including:

- Personal or family history of SUD or overdose
- Depression or other mental health diagnosis
- Age (e.g., older age increases risk of overdose, and younger age increases risk of SUD)
- Underlying renal, hepatic, or pulmonary dysfunction

Query state prescription drug monitoring programs prior to an opioid prescription.

Opioid dose escalation over time can be an indicator of tolerance, exhibited by increasing doses of opioid needed to maintain appropriate pain control.[31] Conversion to another opioid in the acute care setting, rather than increasing doses, is useful in selected patients with opioid tolerance. Many opioid conversion charts are overly simplistic and do not take into account factors such as unidirectional differences in opioid conversion requirements or duration of opioid use.[32] Consultation with a pharmacist or pain specialist may be beneficial when converting between opioids.

Generally, administer opioids orally unless the specific clinical circumstance warrants parenteral administration. Long-acting products (e.g., extended-release preparations and transdermal preparations) are not appropriate for treatment of acute pain and should not be used. Avoid specific products such as meperidine and codeine. Begin opioid tapering as tissue healing occurs—particularly during step-down transitions of care—with a desired goal

of no opioid therapy upon hospital discharge in patients who were opioid-naïve prior to hospitalization.[33]

No "ideal" opioid exists. Base selection on patient-specific factors such as organ dysfunction (e.g., avoiding morphine in patients with renal compromise) and desired duration of action (i.e., fentanyl for premedication in shorter procedures such as chest tubes, but morphine or hydromorphone for breakthrough pain).

Some guidance on starting opioid doses is provided in Table 7. However, specific dosing/tapering regimens for trauma patients vary by injury pattern, organ dysfunction, operative schedules, and several other clinical and demographic factors.

Patient-controlled analgesia (PCA) provides fast pain relief leading to higher patient satisfaction and has safeguards in place to prevent additional doses from being administered in patients who are not oxygenating adequately. However, concern exists that patients may use higher amounts of opioids with PCA administration compared to conventional therapy.[34] PCAs may be a useful adjunct in trauma patients who are unable to take enteral pain medications (e.g., due to bowel discontinuity or ileus).

Guide opioid tapering by the duration of opioid use (acute vs. chronic) as well as anticipated duration of pain. While some general recommendations for long-term tapers and monitoring recommendations for withdrawal exist (e.g., Clinical Opiate Withdrawal Scale), individualize each patient's taper plan.

Adjuvant Analgesics

GABAPENTINOIDS

Patients who experience neuropathic pain often experience insufficient pain control from conventional pain medications. Gabapentinoids (gabapentin and pregabalin) reduce neuropathic pain by inhibiting presynaptic calcium channels. Although gabapentinoid use decreases opioid requirements in select populations (e.g., in patients with spinal cord injury or burn), limited evidence exists to support a broad analgesic effect.[35-38] Additionally, abuse and misuse of gabapentin and pregabalin was reported. Use gabapentinoids with caution in patients with or at risk of developing an SUD. Gabapentinoids, specifically gabapentin, also produce additive CNS depression and increase risk of death when used in combination with opioids.[39] Finally, both pregabalin and gabapentin are renally eliminated, so use lower doses or avoid them in patients with underlying renal disease and in elderly patients.

SEROTONIN-NOREPINEPHRINE REUPTAKE INHIBITORS AND TRICYCLIC ANTIDEPRESSANTS

Serotonin-norepinephrine reuptake inhibitors (SNRIs) (e.g., duloxetine and venlafaxine) and tricyclic antidepressants (TCAs) (e.g., amitriptyline and nortriptyline) have demonstrated improvement for chronic neuropathic pain management.[40] Evidence is limited in acute pain, but one recent study in burn patients

demonstrated reduced pain intensity.[41] Use SNRIs and TCAs cautiously in patients with renal dysfunction and in elderly patients, as they may lead to drowsiness and dizziness.

ANTI-SPASMODIC AGENTS

Patients who experience muscle spasms may benefit from an anti-spasmodic agent, such as cyclobenzaprine, methocarbamol, or diazepam. However, these agents are sedating, and patients need close monitoring. Methocarbamol use in particular is associated with a decreased hospital length of stay in trauma patients with closed rib fractures, and it may play a role in this population.[42]

DEXMEDETOMIDINE

Centrally acting α_2 agonists such as dexmedetomidine (and to a lesser degree clonidine) may offer opioid-sparing effects without respiratory depressant effects. However, data supporting their use for the trauma patient in acute pain are minimal, and cardiovascular effects such as hypotension and bradycardia may limit their use in patients who are hemodynamically unstable.[43] Intraoperative dexmedetomidine may decrease opioid requirements.[44]

LIDOCAINE

Intravenous lidocaine infusions decrease pain by multiple mechanisms of action including sodium channel blockade and inhibition of polymorphonucleocyte priming. Though some evidence exists in the perioperative setting, studies on trauma patients are lacking.[45] In a high-quality, prospective, RCT involving patients undergoing total hip arthroplasty, no difference in pain scores or opioid requirements was observed in patients receiving perioperative lidocaine infusions compared to placebo.[46] Consider regional blocks (neuraxial/peripheral nerve blocks) in patients with localized patterns of injury, but the assistance of an acute pain service is recommended. Topical therapy with lidocaine patches may offer pain reduction with minimal concern for systemic absorption, but its efficacy remains unclear. Use lidocaine patches with caution near open wounds.[47] Do not administer a continuous infusion of lidocaine to patients with a regional block when also infusing an amide anesthetic (e.g., ropivacaine or bupivacaine) due to the risk of local anesthetic systemic toxicity (LAST). See the section on Regional Analgesia. Protocols for recognizing LAST are recommended.

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REGIONAL ANALGESIA

REGIONAL ANALGESIA

Key Points:

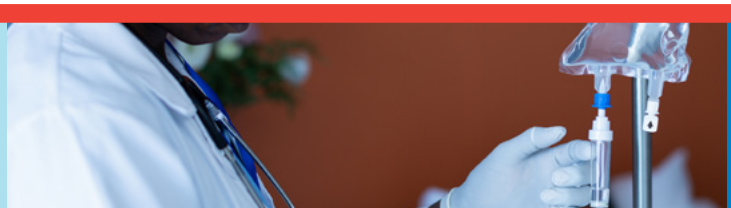
- Regional analgesia, one part of multimodal analgesia (MMA), is a best practice in management of trauma patients.
- Use continuous regional analgesia instead of a single injection technique when pain is expected to last beyond 12 hours.
- For thoracic and abdominal pain, epidural and paravertebral blocks are comparably effective and provide superior analgesia compared to systemic opioids.
- In the setting of acute trauma, regional analgesia of the upper and lower extremities is not contraindicated, but it may potentially mask compartment syndrome.
- Providers who administer or care for patients receiving regional analgesia need to be comfortable identifying and managing local anesthetic systemic toxicity.

Systemic pharmacologic agents commonly used to treat pain in the trauma setting have numerous adverse effects that are particularly undesirable. Relatively recent advances in technology and technique make it possible to perform continuous regional analgesia that can provide analgesia for several days versus hours. Regional analgesia provides superior pain relief compared to systemic analgesia alone, reduces opioid requirements, and may decrease length of stay.[1,2] Consider the incorporation of regional analgesia as one component of a trauma MMA pain management program.

Neuraxial Techniques: Epidural and Paravertebral Blocks

The most common indications for neuraxial blocks are multiple rib fractures and acute postoperative pain following laparotomy or thoracotomy. In patients with multiple or bilateral rib fractures or who are undergoing thoracic surgery, neuraxial block provides superior analgesia and improves oxygenation compared to intravenous patient-controlled analgesia.[3,4] Provision of continuous thoracic epidural analgesia for at least 24 hours after abdominal surgery may improve survival, bowel recovery, and pulmonary function when compared to intravenous opioids.[5] Thoracic epidural and thoracic paravertebral blockade for open laparotomy appear to be comparably effective, with both techniques providing superior analgesia compared to systemic opioids.[1,6]

The thoracic epidural catheter is a safe, traditional technique capable of providing analgesia to a large bilateral region of the body. Almost all practicing anesthesiologists are knowledgeable in this technique, making it available at most institutions; however thoracic epidurals increase the



risk of hypotension, urinary retention, lower extremity weakness, and falls. The thoracic epidural must be removed prior to discharge. A small but significant risk is epidural infection or hematoma that can result in permanent paralysis or death.[7] Epidural catheters are absolutely contraindicated in anticoagulated patients (including those receiving a prophylactic dose of low molecular weight heparin), and they are relatively contraindicated in patients with spinal cord injury or vertebral fracture, and those with depressed mental status.

While not necessary for the placement of thoracic paravertebral catheters, ultrasound guidance may result in superior analgesia and fewer complications (e.g., pneumothorax and bleeding).[8-10] Ultrasound guidance permits safer insertion in patients with depressed mental status or vertebral/spinal injuries. Patients may be discharged home with paravertebral catheters in place. The risk of clinically relevant bleeding is significantly less than with epidural catheter placement. Paravertebral catheters can be placed in patients on therapeutic anticoagulation if the risk of inadequate pain control exceeds the risk of bleeding; for example, in patients with severe rib fractures who may require mechanical ventilation but have inadequate pain relief. Disadvantages of paravertebral catheters include: (1) fewer physicians are knowledgeable about the technique, (2) risk of pneumothorax, (3) less effective cranial/caudal spread for large pain areas with this technique, and (4) two procedures are required to treat bilateral pain.

Trauma patients are at high risk of venous thromboembolism (VTE) and require aggressive pharmacologic prophylaxis. Compliance with the American Society of Regional Analgesia and Pain Medicine's (ASRA) guidelines, *Regional Analgesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy* regarding prophylactic and therapeutic anticoagulation in the setting of neuraxial analgesia is recommended.[11] A user-friendly mobile app, called "ASRA Coags" facilitates compliance with these guidelines (See Table 8).[12]

Ultrasound-Guided Fascial Plane Blocks

Recent advances in the use of ultrasound-guided regional analgesia led to numerous novel fascial plane blocks being introduced into clinical practice, summarized in Table 9. These blocks are technically easier than traditional neuraxial and nerve plexus blocks. For patients who may not receive a continuous neuraxial block because of requirements for VTE prophylaxis, fascial plane blocks—apart from the quadratus lumborum block—may be considered an acceptable alternative.

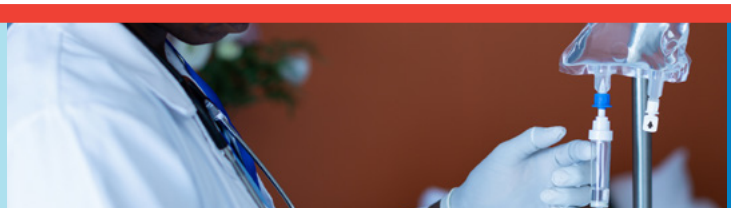


Table 8. Guidance for Use of Neuraxial and Deep Plexus Blocks for Patients Receiving Anticoagulants*

Medication	Neuraxial (e.g., Epidural) or Deep Plexus (e.g., Paravertebral) Block
Apixaban/rivaroxaban**	• Hold 72 hours prior to insertion and 24–30 hours prior to removal • Hold 6 hours following insertion/removal • Hold while catheter is in place
Aspirin	• No restriction
Clopidogrel	• Hold 5 days prior to insertion • No recommendation regarding removal
Dabigatran**	• Hold 3–5 days prior to insertion • Hold 3 days prior to removal • Hold 6 hours following removal • Hold while catheter is in place
Enoxaparin (prophylactic dose)**	• Hold 12 hours prior to insertion/removal • Hold 12 hours following insertion • Hold 4 hours following removal
Enoxaparin (therapeutic dose)**	• Hold 24 hours prior to insertion/removal • Hold 24 hours following insertion • Hold 4 hours following removal • Hold while catheter is in place
Heparin (prophylactic dose)	• Hold 6–12 hours prior to insertion/removal • Start any time after insertion/removal
Heparin (therapeutic dose)	• Hold 4–6 hours prior to insertion/removal • Restart 1 hour after catheter insertion/removal
Prasugrel/ticagrelor	• Hold 7–10 days prior to catheter insertion/removal • Restart 7–10 days prior to catheter insertion/removal • Restart 6 hours after catheter insertion/removal
Warfarin	• Hold 5 days before insertion/removal, or pharmacologically reverse with prothrombin complex concentrate/ phytonadione or plasma/phytonadione. INR should be 1.5 or less at the time of procedure. • Restart 24 hours after catheter insertion/ removal, but monitor neurological exam

*These are guidelines, apply them with clinical judgment to individual patients.
** Agents may need to be held for longer periods in patients with renal dysfunction due to extended half-life.

Excerpt from Horlocker TT, Wedel DJ, Rowlingson JC, et al. Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine evidence-based guidelines (third edition). *Reg Anesth Pain Med.* 2010; 35(1):64-101. doi: 10.1097/aap.0b013e3181c15c70. Used with permission.

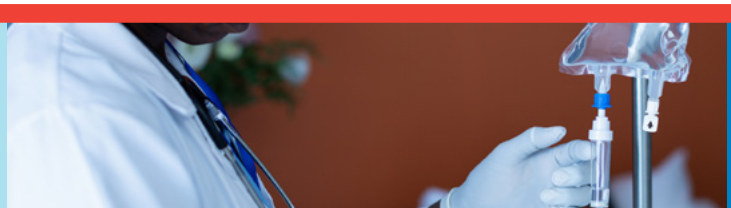


Table 9. Overview of Regional Analgesia in the Trauma Patient*

Block	Region of Analgesia	Indications	Position	Comments
Epidural	Chest, abdomen	Chest or abdominal wall pain	Sitting or lateral decubitus	• Fall risk: lower extremity weakness and urinary retention rare with thoracic epidurals, but common with lumbar epidurals • 5-10% block failure rate • Catheters must be removed prior to discharge
Paravertebral blocks	Chest, abdomen	Chest or abdominal wall pain, Rib fractures	Sitting or lateral	• More limited dermatomal spread in comparison to epidural • May discharge patient with thoracic catheters in place
Serratus anterior plane block	T2-9 anterolateral chest	Chest wall trauma (rib fracture, flail chest), chest tube insertion	Supine or lateral	• Case reports suggest may facilitate extubation[16] • Catheters can be managed outpatient[17]
Transversus abdominis plane (TAP) block	T7-L1 anterolateral abdominal wall	Abdominal wall incisional pain, abdominal wall trauma	Supine	• Provides an opioid sparing effect and reduction in pain intensity in the first 24 hours after surgery[18] • Benefit suggested for most patients with large midline incisions above umbilicus, when combined with multimodal analgesia, but not for all[19-22] • A subcostal or posterior approach is superior to the classical lateral approach for pain management[23,24]
Quadratus lumborum (QL) Block	T7-L1	Abdominal, pelvic, iliac crest, liver, kidney, and bladder pain (intra- and retroperitoneal coverage)	Supine with a lateral tilt, lateral, sitting or prone	• Both single shot and continuous blocks provide significant analgesia and an opioid sparing effect for abdominal and pelvic pain[25,26] • Special Risks: This is considered a deep plexus block. Follow guidelines regarding bleeding risk and VTE prophylaxis in the same manner as with neuraxial blocks. If an epidural is contraindicated, so is the QL block.
Erector spinae blocks	T2-L3 anterolateral thoracic and lumbar areas	Anterior and posterior chest wall trauma	Sitting or lateral	• Improved pain control and incentive spirometry, no effect on opioid consumption[27,28]

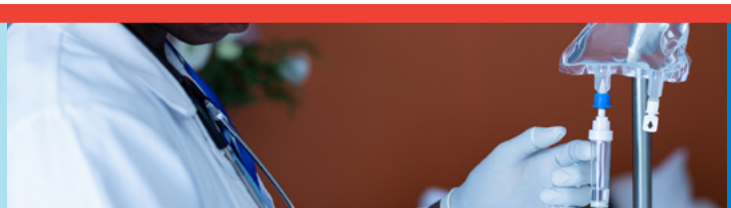
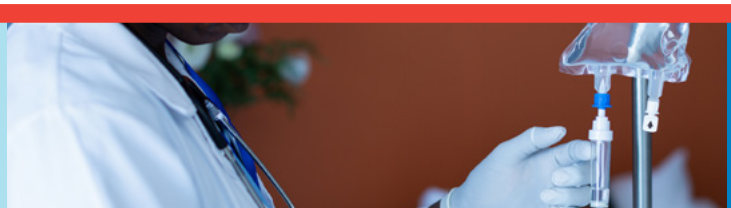


Table 9. Overview of Regional Analgesia in the Trauma Patient* (Continued)

Block	Region of Analgesia	Indications	Position	Comments
Brachial plexus blocks (e.g., interscalene, supraclavicular, axillary)	C5-T1	Clavicular, shoulder, upper arm trauma	Supine	• Interscalene block invariably causes Horner's syndrome and ipsilateral phrenic nerve weakness
Femoral nerve block	L2-4 anterior hip, thigh, and knee	Hip, femur, knee joint trauma	Supine	• Fall risk causes knee extension weakness • Compartment syndrome may be a concern with high-risk or crush injuries
Fascia iliaca block (FICB)	Anterior hip, thigh and knee (more lateral and medial coverage than with a femoral nerve block)	Hip/proximal femur fracture	Supine	• Fall risk causes knee extension weakness • Ultrasound guidance significantly raises the success rate of the block[29] • Compared with intravenous opioids, the FICB provides superior pre- and postoperative analgesia during movement, reduces time to place spinal block, reduces patient discomfort during spinal block[30,31]
Sciatic nerve block	L4-S3	Knee, ankle, and foot trauma	Supine, lateral, or prone	• Fall risk: may block all sensorimotor function in the ankle • Subgluteal approach (patient must be lateral recumbent) • Anterior approach (patient is supine) • Compartment syndrome may be a concern with high-risk or crush injuries

*For deep plexus blocks, compliance with American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines is recommended. These would apply to epidural, quadratus lumborum, brachial plexus, sciatic and lumbar placement.



COMPARTMENT SYNDROME

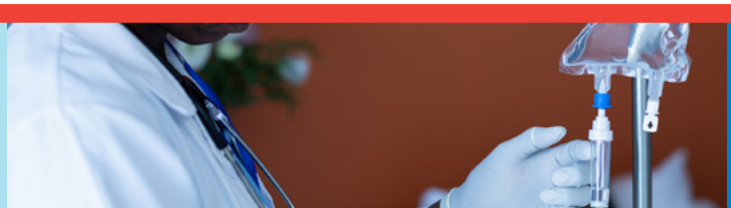
Compartment syndrome is a unique pain scenario which is very important to recognize in the injured patient. Patients at greater risk are those on anticoagulants; those with fractures, crush injuries, or fluid infiltration. Patients with increasing pain scores or analgesic requirements should raise clinical suspicion. Evaluate these patients immediately for compartment syndrome, with urgent fasciotomies performed, if indicated. Use of compartment pressure measuring devices and serial serum creatine kinase level measurements may be indicated, particularly in obtunded patients.

Extremity Blocks: Brachial Plexus, Femoral, and Sciatic

As one component of multimodal analgesia, regional analgesia of the extremities is extremely effective for pain relief. A summary of extremity techniques and associated efficacy is provided in Table 8. Compartment syndrome is of concern in acute trauma to the extremities, especially when comminuted fracture or crush injury is present. Regional analgesia inherently blocks sensory and motor function and can therefore interfere with appropriate and timely diagnosis of compartment syndrome, although the likelihood of this adverse event is not known.[13] Systemic analgesia, specifically with opioids, may also interfere with identification and diagnosis of compartment syndrome.[14] While physicians may offer regional analgesia to patients with traumatic extremity injuries in selected cases, the risk of masking compartment syndrome must be carefully considered. If performing a regional block in a patient at high risk for compartment syndrome, use low doses of analgesia to provide partial sensory/motor block.

Local Anesthetic Systemic Toxicity

Regional analgesia requires an investment in both training and care coordination to provide safe and effective pain relief. Local anesthetic systemic toxicity (LAST) is a treatable complication with the use of regional analgesia. Mild manifestations of LAST include light-headedness, tinnitus, and perioral numbness. More severe cases can present with seizure or cardiac arrest. LAST may occur immediately during block placement or up to 45 minutes after procedure completion.[2,15] LAST can be reversed with appropriate treatment, which includes the rapid administration of 20% lipid emulsion. All care providers who treat patients receiving regional analgesia need to be knowledgeable in the signs and symptoms, diagnosis, and treatment of LAST.



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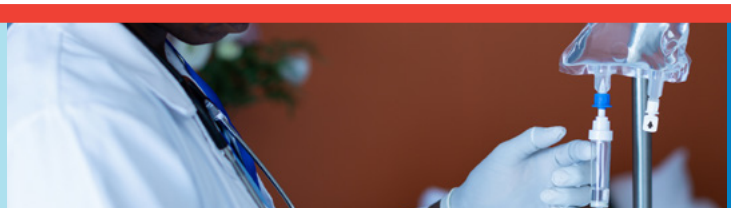

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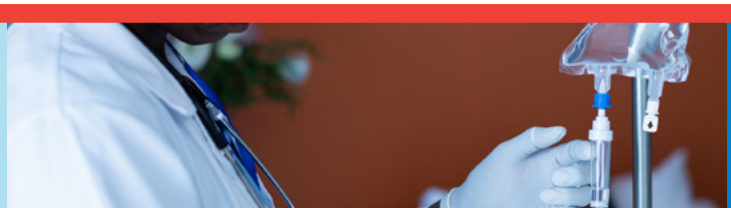


MULITMODAL PAIN MANAGEMENT

MULTIMODAL PAIN MANAGEMENT

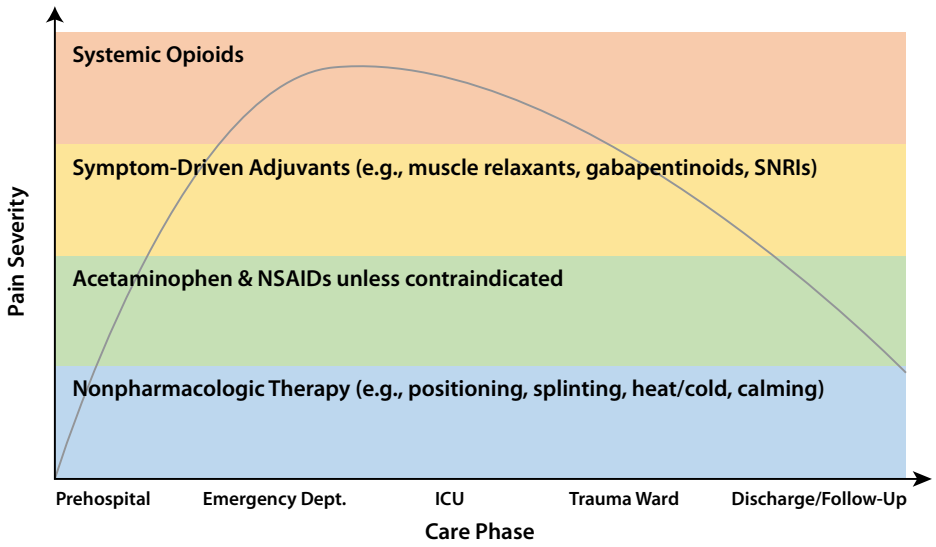
Key Points:

- Patient education about expectations for management is a highly effective intervention for pain management.
- Promptly investigate the cause of increasing pain rather than responding by increasing the analgesic dose or adding new medications.
- Administer acetaminophen and ibuprofen "around-the-clock" to maintain a constant serum level.
- Have a protocol for safe de-escalation of analgesics as quickly as possible.

While it is essential to treat pain, counsel patients that the goal of pain management is not eradication of all pain—they should expect and accept a reasonable degree of pain commensurate with their medical condition. Inform patients that pain is normal after trauma and surgery, medications are meant to alleviate but not remove pain entirely, and the amount of pain may increase as their mobility increases.

Multimodal analgesia (MMA) is the use of multiple analgesics, regional analgesia, and nonpharmacologic interventions to affect peripheral and/or central nervous system loci in the pain pathway. The MMA concept may be applied across the care continuum (Figure 3) with strategies suited to each phase of care (Table 10). Benefits of MMA include the potentiation of multiple

Figure 3. Multimodal Pain Management across the Trauma Care Continuum



Throughout the Care Process

- **Utilize short-acting agents (e.g., intravenous/intranasal opioids or ketamine) as needed for severe acute or procedural pain**
- **Use regional analgesic techniques as much as possible based on patient-specific considerations (e.g., location/severity of injury, risk of compartment syndrome)**

Table 10. Multimodal Pain Management Options across the Trauma Care Continuum

Phase of Care	Multimodal Strategies
Prehospital	• Nonpharmacologic strategies (e.g., positioning, splinting, heat/cold, calming) • Short-acting analgesics (e.g., fentanyl IV, ketamine IV)
Emergency Department	Nonpharmacologic strategies (e.g., positioning, splinting, heat/cold, calming) **Severe pain**: • IV opioids (e.g., fentanyl, hydromorphone, morphine) • Ketamine (IV, IM, IN) • Ketorolac IV **Localized pain**: • Local anesthetic (for painful local injuries or procedures) • Regional blocks **Unless contraindicated**: • NSAIDs (e.g., ibuprofen, celecoxib) • APAP (oral/IV) **For breakthrough pain**: • Oral opioids (e.g., oxycodone, hydrocodone, tramadol)
Perioperative	• Nonpharmacologic strategies (e.g., positioning, splinting, heat/cold, calming) • IV opioids (fentanyl, hydromorphone, morphine, sufentanil) • NMDA antagonists (e.g., ketamine, methadone) • NSAIDs (PO/IV) (*Caution* regarding bleeding/healing risk, especially ketorolac; see section on Pharmacologic Analgesia) • APAP (IV/oral) • Local anesthetic (for painful local injuries or procedures) • Regional blocks • Alpha-2 agonists (e.g., dexmedetomidine) • Lidocaine IV
Intensive Care Unit	• Nonpharmacologic strategies (e.g., positioning, splinting, heat/cold, calming) • APAP (oral/IV) • Opioids (fentanyl, hydromorphone, morphine, oxycodone, tramadol) • Ketamine • Alpha-2 agonists (clonidine, dexmedetomidine) • NSAIDs unless contraindicated (e.g., ibuprofen, ketorolac IV, celecoxib) • Local anesthetic (for painful local procedures) • Regional blocks • Symptom-driven adjuvant therapy (e.g., antiepileptics, SMRs, SNRIs)
Ward	• Nonpharmacologic strategies (positioning, splinting, heat/cold, calming) • APAP/NSAIDs unless contraindicated • Symptom-driven adjuvant therapy (e.g., antiepileptics, SMRs, SNRIs) • Oral opioids (oxycodone, tramadol) • Short-acting IV for procedural/severe pain (e.g., ketamine, opioids, ketorolac) • Alpha-2 agonists (clonidine) • Local anesthetic (for painful local procedures) • Regional blocks
Discharge	• Taper opioids as described in Pain Management at Hospital Discharge section • Transition APAP/NSAIDs to PRN (as needed) as opioids tapered • Consider antiepileptic/antidepressant/clonidine taper or transition plan if used for analgesia, depending on duration and extent of exposure • If beneficial, SMRs may be continued 1–2 weeks after discharge

medication effects and greater pain control without relying on any single class of medication or strategy.[1] MMA therefore may mitigate the risk profile of each medication or strategy, while allowing for synergistic pain control from different analgesic strategies.

Administer nonopioid analgesics (e.g., acetaminophen and NSAIDs) on a scheduled basis rather than "as needed" to mitigate serum peak and trough level variation. Agents such as ketamine and systemic lidocaine are also safe and effective components of an MMA strategy.[2-5] Successful MMA should offer acetaminophen (APAP), NSAIDs, opioids, adjuvant analgesics, local and regional analgesia, cognitive modalities, and physical modalities. Recent reviews, meta-analyses, and RCTs have demonstrated MMA effectiveness in the perioperative period.[6-8]

A key aspect of effective MMA is patient engagement—assuring that the risks and benefits of each component of their treatment regimen is understood.[9] Furthermore, counsel patients that APAP and NSAIDs are truly analgesic medications, and not "just over-the-counter medications."[10] Establish realistic expectations with the patient, including a de-escalation regimen, as early as possible in the course of therapy as illustrated in Figure 3.[11]

Ideally, the trauma service should collaborate with pain specialists, nonpharmacologic treatment providers, and psychiatrists/addictionologists to create a patient pathway for comprehensive pain management and safe de-escalation in patients with complex pain management needs.

Multimodal Rib Fracture Pain Management

- Scheduled acetaminophen
- Scheduled NSAIDs
- Muscle relaxants (if not contraindicated)
- Paravertebral block/epidural/ intercostal block
- Consider lidocaine patch if regional analgesia cannot be administered
- Oral opioids with breakthrough intermittent IV doses
- Operative rib fixation

Morbidity and mortality from rib fractures result from poorly controlled pain and associated splinting that leads to altered breathing mechanics, hypoventilation, and impaired gas exchange resulting from an underlying lung parenchymal injury. Poorly controlled pain from rib fractures contributes to an increased risk of pneumonia, acute respiratory distress syndrome, and respiratory failure. Patients who are older than 65 years, have three or more rib fractures, or with underlying cardiopulmonary disease are at greatest risk of morbidity and mortality.[12]

Management of rib fracture pain requires a multimodal approach that is determined by the patient's comorbidities and response to therapy. The available tools are outlined in this guideline.

- Begin scheduled acetaminophen and NSAIDS as soon as possible.
- If a regional block is likely, select a COX-2 inhibitor to avoid platelet inhibition.
- Muscle relaxants, if not contraindicated, may help relieve chest wall muscle spasm, and evidence suggests they reduce length of stay and respiratory complications in rib fracture patients.[13]
- Consider the early use of regional analgesia to avoid the potential complications of opioids.[14-16] An epidural is preferred for treatment of patients with bilateral rib fractures, but paravertebral blocks can be used when an epidural is contraindicated. Intercostal blocks with liposomal bupivacaine are another option when patients may have contraindications to paravertebral or epidural blocks such as coagulopathy or spine fractures.[17]
- The addition of opioids begins with oral administration and may include breakthrough rescue doses of intermittent IV opioids with escalation to a PCA if multiple rescue IV doses are required.
- For continued rib pain, consider operative rib fixation.

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PAIN MANAGEMENT IN THE PREHOSPITAL SETTING

PAIN MANAGEMENT IN THE PREHOSPITAL SETTING

Key Points:

- Emergency medical services (EMS) pain management protocols need to include several therapeutic options for pain management to allow for individualized patient care.
- Analgesic dose ketamine is the ideal primary analgesic because of its limited hemodynamic effects.
- When within the EMS providers' scope of practice and clinically appropriate, analgesics should be administered en route, even for short transports.
- Trauma patients who receive pharmacologic analgesia must receive close monitoring of vital signs, oxygen saturation, and continuous end-tidal CO_2 to detect any deterioration in their condition.

Pain management in the prehospital setting is heavily dependent upon the skills and scope of practice of the EMS provider. Patient care provided in the EMS environment is driven by protocols developed and approved by the authorized entity specified in a state's EMS regulations, such as the state office of EMS, a regional EMS council, or the EMS agency's physician medical director. Due to the small space and storage characteristics of ambulances, the number of pain management medications that can be stocked often limits choices available. Coordination between the trauma service and the EMS medical director is essential for optimal patient care and system integration.

Nonpharmacologic pain management techniques commonly used by EMS providers include positioning, splinting, the use of cold or heat therapies, and calming techniques. Insufficient evidence exists currently to either support or oppose use of other nonpharmacologic techniques by EMS.

Use of pharmacologic pain interventions in the EMS environment requires both the presence of an advanced-level EMS provider and clinical protocols that permit their use. Ideally the protocols include several therapeutic options to allow for a tailored pain management plan to fit an individual patient's needs, and to mitigate the effects of multiple unplanned drug shortages that EMS systems often face. EMS providers practice under their medical director's license, so the EMS agency physician medical director (or in some cases the regional EMS medical advisory regulatory body) maintains final say regarding the content of EMS protocols, and thus oversight of EMS provider practice. These protocols guide the EMS provider in the choice of pharmacologic agents, based on the most appropriate available interventions when considering:

- The patient's hemodynamic, respiratory, and mental status
- Severity of patient pain
- Time to therapeutic effect, duration of effect, and duration of patient contact with EMS
- The needs of special patient populations (pediatric, geriatric, pregnancy, renal and/or hepatic impairment)

EMS providers must exercise utmost caution when choosing pharmacologic intervention and dosing to avoid precipitating or exacerbating existing hypoxia, respiratory insufficiency, apnea, and/or hypotension in the injured patient, specifically those with head injuries.[1] Pharmacologic analgesia en route is indicated in significant trauma, even during short transports. Trauma patients who receive pharmacologic analgesia must receive close monitoring of vital signs, oxygen saturation, and continuous end-tidal CO_2 to detect any deterioration in their condition. Agitation or restlessness may indicate subtherapeutic analgesic dosing rather than need for additional sedation. Due to their limited effects on hemodynamic status, the use of nonopioid analgesics is strongly recommended; particularly analgesic dose ketamine as first-line EMS pain management.[2,3] Fentanyl is recommended if opioid pain medication is needed in a prehospital trauma patient.

Advanced EMS providers need to consider the additive or synergistic effect of analgesics and sedatives on a patient's hemodynamics, respiratory drive, and mental status when using analgesics in combination with sedatives (e.g., benzodiazepines, ketamine, etomidate). Methoxyflurane is commonly used in prehospital systems in Australia and Europe, and clinical studies are ongoing in the United States.[4,5] As of the date of this draft, methoxyflurane is not approved by the Food and Drug Administration (FDA) for this purpose in the US. Approval is anticipated in 2020.

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PAIN MANAGEMENT IN THE EMERGENCY DEPARTMENT

PAIN MANAGEMENT IN THE EMERGENCY DEPARTMENT

Key Points:

- Medication effects may be magnified in hemodynamically unstable patients. Consider analgesic-dose ketamine and/or fentanyl as first-line options for unstable patients with severe pain.
- Ultrasound-guided nerve blocks are effective analgesic strategies, particularly in patients with contraindications to more invasive techniques.
- Patients with a history of chronic opioid use or SUD often have greater analgesic needs than opioid-naïve patients, and providers should not withhold opioids solely due to a history of SUD.

Emergency department (ED) care of the trauma patient focuses on initial resuscitation, diagnostic workup, and ongoing management. Because the patient may arrive before a trauma surgeon is present, protocols developed in collaboration with the trauma team need to be in place to guide care. These protocols need to include pain assessment and management strategies while accounting for hemodynamic status and prioritizing resuscitation. Prioritize nonpharmacologic techniques for pain management when possible. Medication selection must focus on those with the least negative effects on hemodynamic status.

Similar to other phases of care, MMA is critical for provision of adequate analgesia to the acutely injured patient in the ED; however, patient hemodynamic, respiratory, and mental status must all affect the choice of pharmacologic interventions.[1] Hemodynamically unstable patients may still require analgesia, but use caution with many agents—specifically oral therapies and opioids—due to decreased absorption or worsening of a shock state. Analgesic-dose ketamine is an attractive option for many patients due to its quick onset, short duration of action, limited CNS depression, and minimal negative physiologic and hemodynamic effects.[2] Multiple studies support use of analgesic-dose ketamine in the ED as a single agent or adjuvant to reduce opioid requirements.[3-5] Fentanyl has clear advantages over other opioids in the initial resuscitation phase and ED management of trauma patients because of its minimal effects on hemodynamic status and lack of CNS depression. However, because of fentanyl's relatively short half-life, frequent pain reassessments and re-dosing are needed.

Ultrasound-guided nerve blocks (UGNBs) are also effective analgesics (see the Regional Analgesia section).[5] A primary barrier to widespread implementation of UGNBs is the physical location of supplies in the ED. Pre-arranged

"block bags" may increase availability in EDs.[6] EDs must have policies and procedures in place, including training regarding LAST, if UGNBs are provided.

Drug shortages and limited patient history; specifically regarding analgesic use, chronic pain diagnoses, SUD, and drug allergies; complicate analgesia provision in the ED. Access to pre-calculated dosages for infants and children based on height, weight, and age; clinical decision support; and clinical pharmacy support services are recommended for all ED providers.[7-9]

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PAIN MANAGEMENT IN PERIOPERATIVE CARE

PAIN MANAGEMENT IN PERIOPERATIVE CARE

Key Points:

- Opioids remain the cornerstone of perioperative analgesia but are associated with an increased risk of postoperative complications (e.g., ileus).
- Multiple intraoperative adjunctive therapies, such as ketamine, methadone, dexmedetomidine, and magnesium are associated with decreased postoperative opioid requirements.
- Analgesic-dose IV ketamine is recommended as a perioperative adjunct in patients anticipated to experience moderate-to-severe postoperative pain, patients with opioid tolerance, and as an adjunct in patients with obstructive sleep apnea.

Preoperative Care

Certain medical comorbidities deserve specific mention with regard to the potential impact on periprocedural pain management:

Neurocognitive disorders, such as SUD, will affect analgesic requirements.[1]

Ischemic cardiac disease has implications because pain and stimulation increase myocardial oxygen consumption, leading to a subsequent imbalance of oxygen supply-demand.

- Pulmonary dysfunction (e.g., obstructive sleep apnea) is a less commonly recognized comorbidity with significant impact on pain management strategies and pulmonary rehabilitation.[2] An appropriate selection of periprocedural analgesics is critical to minimizing exposure to longer-acting sedative medications, which are associated with increased apneic events and complications in patients with already compromised pulmonary reserve.
- For renal and hepatic organ system diseases, dose adjustment is needed for many frequently administered pre- and intraoperative analgesics in patients with hepatic (e.g., fentanyl, morphine, sufentanil, acetaminophen) or renal (e.g., morphine, NSAIDs, gabapentin) impairment.
- Evaluation of coagulation disorders is prudent in any patient considered for regional or neuraxial anesthetics.[3]

Intraoperative Care

OPIOIDS

Providers must consider several drug characteristics (e.g., onset and duration of action, metabolic pathway and active metabolites, impact of organ dysfunction, etc.) when choosing an intraoperative analgesic. Because of established efficacy, familiarity, and favorable pharmacokinetics, opioids such as morphine, fentanyl, and

hydromorphone remain the cornerstone of intraoperative analgesia against which all other analgesics are compared.

NMDA ANTAGONISTS

Meta-analyses demonstrate that perioperative administration of analgesic-dose IV ketamine is associated with significantly decreased opioid requirements in the postoperative period.[4,5] However, the difference in postoperative visual analog scale (VAS) scores in patients who received ketamine has been more variable and difficult to define. In concordance with recent consensus guidelines from the American Society of Regional Anesthesia and Pain Medicine, the American Academy of Pain Medicine, and the American Society of Anesthesiologists, analgesic-dose IV ketamine is recommended as a perioperative adjunct in patients anticipated to experience moderate-to-severe postoperative pain, patients with opioid tolerance, and as an adjunct in patients with obstructive sleep apnea.[6]

Methadone is re-emerging as a valuable option for acute perioperative analgesia. In opioid-naïve patients experiencing acute pain, administration of IV methadone while under general anesthesia (initial single bolus-dose of 0.2 mg/kg following anesthetic induction) is a safe and effective option. Recent prospective, randomized studies in both complex spine operations and outpatient ambulatory procedures demonstrated that intraoperative administration of IV methadone resulted in decreased consumption of opioids and improved VAS scores (for three months postoperatively), with no difference in postoperative respiratory complications.[7-11] Additionally, methadone inhibits both serotonin and norepinephrine reuptake and may theoretically elevate mood postoperatively as well.

A recent meta-analysis reported that intraoperative systemic administration of high-dose magnesium was associated with decreased opioid consumption and reduced early (within 4 hours) and late (at 24 hours) postoperative pain scores.[12] Other NMDA antagonists such as memantine or dextromethorphan have limited utility in the perioperative setting.

DEXMEDETOMIDINE

Dexmedetomidine represents another option and adjunct in the intraoperative MMA approach to pain management following acute injury, but its use may be limited by the drug's hemodynamic effects. A recent Cochrane analysis reported that intraoperative dexmedetomidine compared to placebo decreased opioid requirements in patients undergoing intra-abdominal operations; however, the overall impact on pain scores or potential side effects (e.g., hypotension, bradycardia, decreased bowel motility) was not quantified due to the limited size and small number of studies.[13]

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PAIN MANAGEMENT IN THE INTENSIVE CARE UNIT

PAIN MANAGEMENT IN THE INTENSIVE CARE UNIT

Key Points:

- Validated measurement tools to assess pain are an important component of any analgesic program in the ICU.
- An ICU MMA protocol is needed to match medications and their doses/titration to the severity of the patient's pain.
- Use opioids as first-line agents for patients with severe, acute nociceptive pain in the ICU setting as part of an MMA pain management plan.
- Consider patient comorbidities and medical history (e.g., alcohol or SUD and chronic renal failure) when choosing medications for analgesia and sedation.
- Transition patients from parenteral to enteral medications prior to transfer from the ICU, when possible.

The intent of these guidelines is to increase the use of MMA and to improve pain management for the more than 50% of patients who report inadequate pain relief while in the ICU.[1] MMA decreases opioid requirements in the ICU,[2] and a recent survey of trauma surgeons documented that they were prescribing fewer opioids.[3] A full discussion of pain management in the ICU is beyond the scope of this section, though recent, high-quality guidelines from both the Society of Critical Care Medicine and the Orthopaedic Trauma Association can aid those who desire more in-depth evidenced-based reviews.[4,5] While this section focuses on the management of patients who have sustained injury; critically ill surgical, trauma, and medical patients differ little with respect to their pain needs while in an ICU.[6]

It is imperative to account for a patient's past medical history and comorbidities when choosing an analgesic regimen. Patients with SUD (including alcohol and tobacco) prior to admission are often an MMA challenge when attempting to manage alcohol or drug withdrawal and achieve satisfactory levels of analgesia.[7]

It is important to recognize that under- and over-treatment of pain contributes to the development of chronic pain syndromes, specifically in the ICU. Chronic pain syndromes are common following trauma and surgery, and it is naïve to think that chronic pain syndromes can be alleviated by better pain management.[8] An increasing number of reports address hyperalgesia in response to opioids and the relation of hyperalgesia to chronic pain syndrome development.[9,10] The goal is to avoid inadequate pain management[11] while assuring the analgesia provided matches the severity of pain experienced by the patient.[7,12]

In general, having a protocol or standardized method for the assessment and treatment of pain, anxiety, and

delirium in the ICU is more important than any given drug class or dosage.[13] The first priority for treating ICU patients is pain management, with opioids if necessary. Add other analgesics as appropriate, to decrease the total dose of opioids administered. Provide adequate sedation as a secondary target, typically with benzodiazepine-sparing regimens. Light-to-moderate levels of sedation, along with daily sedation holidays when appropriate, are advocated and associated with decreased opioid consumption, an increased number of ventilator-free days, a decreased incidence of delirium, and a decreased length of stay in the ICU.[14-16]

Sleep disruption is a source of distress for many patients with critical illnesses. It is characterized by sleep fragmentation, which is correlated with an increased pain perception. A study using healthy volunteers demonstrated that sleep disruption during the night was associated with an increase in experimental pain perception the following day.[17,18] An association between sleep disruption and degree of postoperative pain was reported,[19] and it is expected that sleep disruption will impact pain in trauma patients who are critically ill. Considerable interplay exists between the degree of pain patients experience and their sleep efficiency. Patients in pain have poor sleep while those with better pain control sleep better.[19] Some valid reasons for sleep disruption exist (e.g., frequent neurologic assessments), but many patients have sleep disrupted for minor reasons.[20] A first step in nonpharmacologic pain management of patients with critical injuries is the use of sleep promotion protocols that reduce in-room activity and unwanted noise during rest hours.[21-23]

Pharmacologic Analgesia

Parenteral opioids remain the standard of comparison for all medications used for severe, acute nociceptive pain in the ICU.[24] As in non-ICU settings, MMA with nonopioid medications and nonpharmacologic interventions are important as opioid-sparing or opioid-replacement therapies. However, many nonopioid analgesics have limitations (e.g., oral administration, concomitant disease state contraindications) that may preclude or complicate their use in the ICU.

DEXMEDETOMIDINE

The use of the alpha-agonist dexmedetomidine, or clonidine, as an adjunct to decrease the cumulative dose of opioid is increasing. A 2016 Cochrane review of dexmedetomidine for pain following abdominal surgery concluded that its use seemed to decrease the use of opioids, but the quality of the studies included in the analysis was poor.[25] In 2019 the Sedation Practice in Intensive Care Evaluation investigators (SPICE III) published the results of an open-label RCT with more than 3,900 patients (1,948 in the dexmedetomidine group and 1,956 receiving usual care with propofol or midazolam).[26] No difference in mortality was found, but the dexmedetomidine group required additional sedative drugs

to achieve an adequate comfort level, and they had more adverse events. Of note, the dexmedetomidine group had a higher incidence of hypotension and bradycardia, and a sevenfold increase in the incidence of asystole (0.7% compared with 0.1% in the usual care group).[26] When dexmedetomidine is used, it is recommended that health care providers be aware of the drug's adverse reactions, and taper or discontinue it if hypotension or arrhythmias occur.

KETAMINE

Administered continuously, and by low dose, IV analgesic-dose ketamine decreases opioid requirements without effects on hemodynamics.[27,28] Single bolus doses of 0.5 mg/kg and higher do not appear to produce a durable response, but the risk of psychiatric adverse reactions is increased.[29]

REGIONAL ANALGESIA

Regional analgesic techniques such as paravertebral nerve blocks play an important role in managing pain in certain populations in the ICU (e.g., rib fractures with flail chest), decreasing both opioid consumption and ICU length of stay.[30] Regional analgesic techniques for extremity injuries decrease the need for analgesic medications;[31] and therefore, may allow for more frequent and better neurologic assessment in patients with traumatic brain injury (TBI). Additionally, trauma patients requiring laparotomies who receive analgesic nerve blocks require less opioid and nonopioid analgesia during their ICU stay.[32]

Transition Out of Intensive Care

Patients often experience anxiety when transferring from the ICU to a lower level of care because of concerns about changing care environments, and this anxiety can be increased by inadequate pain management. Regardless of cause, an association exists between patient anxiety and the development of depression, chronic pain syndromes, and post-traumatic distress syndrome (i.e., the post-intensive care syndrome).[33] The techniques mentioned previously, including a focus on decreasing the level of daily sedation, early mobilization and ambulation, and psychological interventions, are imperative to improve the transition from a higher to a lower level of care. To ensure a successful transition:

- Routinely reassess analgosedation as part of daily awakening in ventilated patients
- Switch all eligible patients from parenteral to enteral/ oral analgesia combined with frequent ICU nurse monitoring
- Assure adequate pain control and assessment prior to transfer to the lower level of nursing care
- Exercise caution when using potentially sedating analgesics (e.g., opioids, gabapentinoids, skeletal muscle relaxants, etc.) in older adults to prevent oversedation, delirium and other side effects

Poor communication during handoffs can increase the frequency of adverse events.[34] Because pain levels prior to dismissal from the ICU are the best predictors of pain on the ward, poor communication can contribute to inadequate pain management following transfer. The delivery of optimal analgesia to ICU patients often requires multiple, simultaneously occurring pharmacologic and nonpharmacologic interventions. With such complexity, a structured hand-off facilitating communication between care teams is warranted.[35]

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PAIN MANAGEMENT AT HOSPITAL DISCHARGE

PAIN MANAGEMENT AT HOSPITAL DISCHARGE

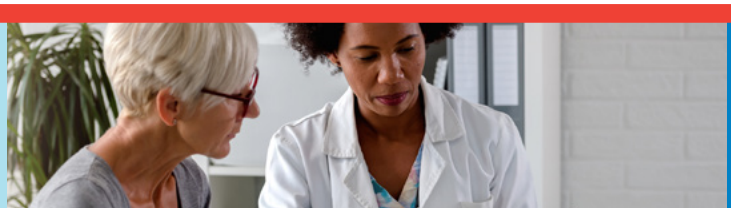
Key Points:

- The type, amount, and duration of opioids issued at discharge must balance the risks of inadequate pain control against the likelihood of sustained prescription opioid use, misuse, abuse, and SUD.
- The amount of opioid given in the 24 hours prior to discharge may predict postdischarge opioid requirements.
- Discharge prescriptions should separate opioids and nonopioid analgesics to more easily taper opioid use.
- Educate patients prior to discharge regarding individualized risk factors associated with sustained prescription use, an individualized analgesic plan, and an anticipated timeline for weaning.

Assessment Considerations

Considerations regarding the type, amount, and duration of prescription opioids issued at discharge following injury are among the most important in the context of the opioid epidemic. The type (and amount) of opioid issued at discharge is thought to greatly influence the proclivity for sustained prescription opioid use, abuse, and addiction.[1-8] Additionally, prescription opioids not consumed by the patient (e.g., because too many pills were issued, or too large a dose was prescribed) can influence opioid abuse and addiction in the community through diversion or illicit use by other individuals.[1] The type, amount, and duration of opioids issued at discharge must balance the risks of inadequate pain control (with attendant consequences of reduced patient satisfaction, increased office calls, ED visits, and readmission) against the likelihood of sustained prescription opioid use, misuse, abuse, and addiction.[1,7-11]

Most patients who are sustained prescription opioid users did not initiate sustained opioid use following surgery or an inpatient hospital encounter.[12] The majority of cases derive from outpatient encounters, typically for back pain or other poorly described medical complaints.[12] The prevalence of sustained prescription opioid use for up to 6 months following surgery is reported to be in the range of < 1–45%, depending on the population studied, the exposure, and the prevalence of prescription opioid use prior to the intervention.[1,5,6,13-15] Among opioid-naïve patients, following surgical intervention for elective spinal conditions or trauma, the likelihood of sustained prescription opioid use is documented at or below 1%.[13,15] Among those already exposed to opioids, or actively using them at the time of surgery, the rates of sustained prescription use following discharge are much higher—over 10% in a recent study of patients treated for traumatic orthopaedic injuries. This suggests that providers



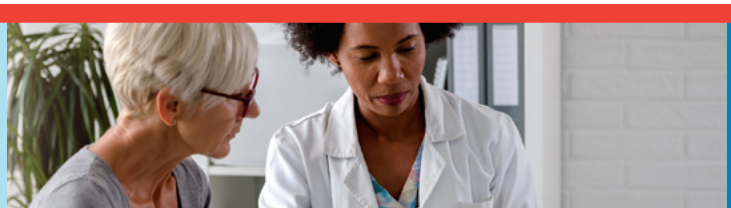
need to be particularly cautious in this population to avoid further exacerbation of a chronic opioid use disorder.[6]

Sustained prior opioid use (i.e., opioid use for at least 6 months) significantly increases the likelihood of long-term opioid use after surgery or admission for trauma.[5,6,8,14,16,17] This definition of sustained preoperative use as a benchmark for measuring the potential for postoperative dependence has been externally validated in the work of Oleisky et al.[17] Other patient risk factors identified in most rigorous studies include patient age (typically younger to middle age depending on the referent), socioeconomic status, history of psychiatric disorders, and intensity of the surgical intervention. Opioid requirements and the individualized potential for sustained prescription use are also influenced by the inpatient experience and the type of surgery performed.[7,8,13]

Much less information is available regarding the influence of preoperative and in-hospital opioid type (e.g., hydrocodone vs. oxycodone vs. sustained-release vs. synthetics). The information that is available is highly confounded by small study samples, single center practice, and selection/indication bias for the types of opioids used. A general recommendation is to discharge patients on a type and dose of opioid comparable to that performing adequately in the inpatient environment following a surgery.[7,11] Educate patients prior to discharge regarding the risk factors associated with sustained prescription use, an anticipated plan for weaning from opioids, and an envisioned timeline for transition to nonnarcotic analgesics. Include discussions about the role of nonpharmacologic pain management modalities, cognitive-behavioral techniques, self-efficacy and optimism, and other nonpharmacologic adjuncts such as ice packs. Have a clear plan for outpatient follow-up and decide if renewal of opioid medications may occur beforehand or only at the time of office reevaluation.

Considerations for Pharmacologic Analgesics

Ideally, health care providers have an accessible and pragmatic means of determining the risk of sustained prescription opioid use that can be directly applied in clinical practice and used to inform the type and duration of prescription opioids issued at discharge. Several tools exist for the determination of risk for sustained opioid use, but none are definitively validated, and their performance may vary depending on the population assessed.[1,8,18-20] An automated score, calculated by an algorithm that pulls characteristics directly from the electronic medical record (EMR) or smartphone app is envisioned as a means to modulate opioid prescribing at discharge.[1,8] Seymour et al., described this in the form of EMR prescribing alerts (akin to allergy alerts), but more as a general warning highlighting a potential for misuse or abuse.[1] Another option, the Opioid Risk Tool, takes into account patient family history, prior history of drug use, and psychosocial comorbidities.[20] The recently described Stopping Opioids



after Surgery (SOS) score is a risk stratification tool intended specifically for discharge planning (Table 11).[8,18] The SOS accounts for sociodemographic and clinical characteristics, including the type of surgery (categorized as major [involving organ space or bone resection] or minor [soft-tissue only, endoscopic/arthroscopic]), hospital length of stay, duration of preoperative opioid exposure, and history of psychiatric comorbidity.[8,18] Most factors necessary to determine the score are easy to determine and convey to patients. A validation study using a battery of spine surgical patients reported the risk of sustained prescription opioid use was 4% in low-risk patients, 17% in those with intermediate risk, and close to 50% in the high-risk category.[8]

When issuing prescription opioids at discharge, carefully assess the proclivity for sustained prescription opioid use by considering the following:

- Sociodemographic and clinical characteristics
- Prior history
- Type and nature of opioid exposure
- Comorbid psychiatric illness
- Type and dosage of in-hospital opioid medications required for adequate pain control

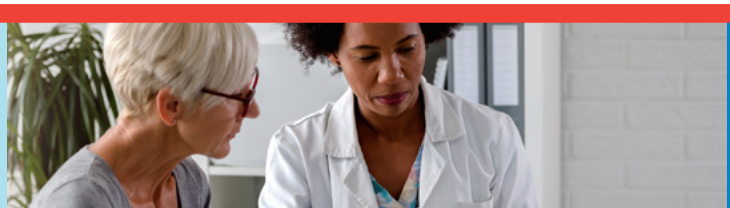
The goal is to issue a prescription that provides effective pain control with the lowest dosage and duration of prescription opioid possible, including no prescription for outpatient opioids if appropriate. Prescribing more opioid

Table 11. Characteristics of and Scoring for the Stopping Opioids After Surgery (SOS) Score.

Characteristic	Scoring
Age	
18-24	0
25-34	3
35-44	4
45-54	4
55-64	4
Biologic Sex	
Male	0
Female	3
Discharge Status	
Home	0
Non-Home Discharge	11
Socioeconomic Status	
High	0
Low	5
Procedure Category	
Minor	0
Major	4
Length of Stay (Days)	
3 or less	0
4 or more	1
Past Medical History	
Depression	4
Anxiety	4
Any prior opioid use	17
Prior sustained opioid use	36
Total Score	

*Circle the score for each category and add together. Maximum total score is 100. Scores < 30 are considered low-risk, scores 30-60 are intermediate-risk and scores > 60 are high-risk.

From: Chaudhary MA, Bhulani N, de Jager EC, et al. Development and validation of a bedside risk assessment for sustained prescription opioid use after surgery. JAMA Netw Open. 2019;2(7): e196673. Used with permission.



than needed can result in leftover pills, which are then available for diversion or inappropriate use. Some patients feel the need to continue taking the opioid pills "because they were prescribed," increasing the risk for developing sustained opioid use. However, multiple studies demonstrated that excessive opioid prescribing does not correlate with consumption.[16,21,22] In a large, retrospective population-based Michigan study, the routine number of opioid pills prescribed was 30, but median consumption was 9.[23] Opioid requirements in the 24 hours prior to discharge appear to predict postdischarge opioid requirements.[24-26] In a study of patients who underwent a variety of abdominal procedures, postdischarge opioid use was best predicted by usage the day before discharge:[27]

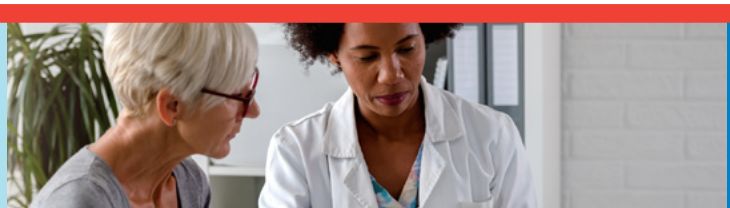
- For patients administered no opioids prior to discharge, the mean number of pills required postdischarge was 1.5 pills.
- For patients administered 1 to 3 pills prior to discharge, the mean number of pills required postdischarge was 7.6 pills.
- For patients administered more than 4 pills in the 24 hours prior to discharge, the mean number of pills required postdischarge was 21.2 pills.

See Table 12 for an individualized discharge opioid prescribing and tapering protocol for joint replacement and spine patients. The discharge opioid pill count and tapering schedule was based on the prior 24-hour inpatient opioid consumption.[22] Whether the opioid

Table 12. Tapering Instructions and Number of Pills to be Prescribed at Discharge

Tapering Instructions (Prescribed As-Needed)							
Prior 24-hour Oxycodone (mg)	Days 1-2	Days 3-4	Days 5-6	Days 7-8	Days 9-10	Days 11-12	Total Oxycodone 5 mg Tablets Prescribed (n)
10 mg	5 mg twice daily						4
20 mg	5 mg four times daily	5 mg twice daily					12
30 mg	5 mg six times daily	5 mg four times daily	5 mg twice daily				24
40 mg	10 mg four times daily	10 mg three times daily	5 mg four times daily	5 mg twice daily			40
50 mg	10 mg five times daily	10 mg four times daily	10 mg three times daily	5 mg four times daily	5 mg twice daily		60
60 mg	10 mg six times daily	10 mg five times daily	10 mg four times daily	10 mg three times daily	5 mg four times daily	5 mg twice daily	84

From: Joo SS, Hunter OO, Tamboli M, et al. Implementation of a patient-specific tapering protocol at discharge decreases total opioid dose prescribed for 6 weeks after elective primary spine surgery. *Reg Anesth Pain Med*. 2020; 45(6): 474-478. doi:10.1136/rapm-2020-101324. Used with permission.



pill is used alone or in combination with acetaminophen or ibuprofen, no difference in efficacy, tolerability, or risk of abuse or misuse was found.

To optimize the use of acetaminophen or NSAIDS before opioids, prescribe oral opioids alone. This eliminates confusion about the maximum dose of the nonopioid component when used in combination form. For patients believed to require longer prescription duration, consider consultation with a pain management service for delineation of an optimal outpatient pain management regimen. In line with Centers for Disease Control recommendations, consider providing naloxone as a co-prescription for patients felt to be at high risk for opioid overdose.[28]

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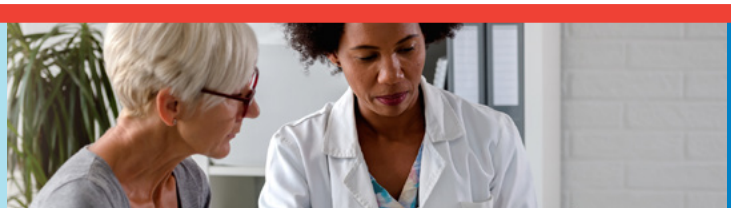

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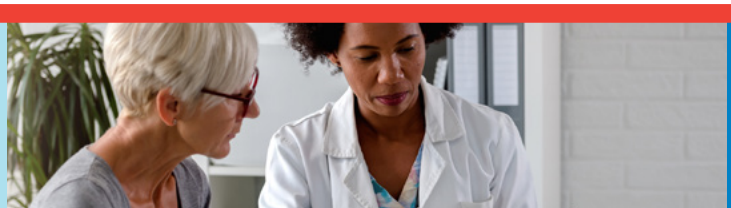


PAIN MANAGEMENT IN OLDER ADULTS

PAIN MANAGEMENT IN OLDER ADULTS

See also *TQIP Geriatric Trauma Management Best Practice Guidelines*.

Key Points:

- Standard unidimensional pain rating scales may require modification or be inappropriate for pain assessment in older adults.
- Physiologic changes that occur with aging may alter both pain perception and response to medications.
- Because older adults are more sensitive to sedating, gastric irritation, and anticholinergic effects of medications, starting doses need to be empirically reduced.

The older adult population is the fastest growing segment of the population, and nearly half of trauma admissions are estimated to involve patients over 65 years by 2050.[1,2] Pain treatment of the older adult patient is complicated by the presence of coexisting illness, use of concomitant medications, and depression. A complete medical history, including prescription medications, over-the-counter medications, and herbal supplements is essential in order to avoid potentially harmful drug interactions.

The steady decline of multiple homeostatic mechanisms and organ system functions associated with aging alters both the pain and analgesic responses. Age-related decreases in myelinated fibers may reduce sensitivity to low intensity pain but do not appear to significantly impact pain tolerance.[3-5] Additionally, pain management of older adults is complicated by improper assessment, patient underreporting, and concerns about tolerance and addiction to opioids.[6]

Medications in the Aging Population

Older adults have decreased total body water and an increase in adipose tissue, which alters drug distribution and clearance.[7] Age-related declines in hepatic function may reduce drug clearance by up to 40% in the older adult. Decreases in serum albumin concentrations reduce protein binding; increasing distribution volume and free concentration of highly-bound drugs, such as NSAIDs.[8] Due to changes in body composition, variable reductions in the glomerular filtration rate may be underestimated by standard laboratory values (e.g., serum creatinine).

The pharmacodynamic effects of medications also vary drastically from younger adults. See Table 13. Diminished response by the CNS to hypercapnia, combined with reduced pulmonary reserve, exaggerates the respiratory depressant effects of opioids and benzodiazepines.[9,10] Variations in baseline prostaglandin concentrations may increase the risk of both renal and gastrointestinal injury with NSAID use.[11,12] Decreased cholinergic receptors increase sensitivity to anticholinergic effects of medications.[13]

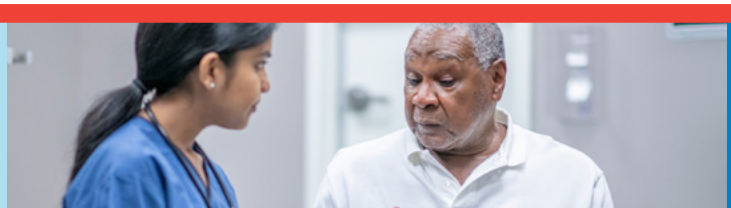


Table 13. Potentially Inappropriate Analgesics for Older Adults

Medication	Recommendation	Rationale
NSAIDs[A]	Avoid chronic use unless alternatives are not available. When used, combine with gastroprotective agent (e.g., PPI or misoprostol)	Increased risk of upper gastrointestinal bleeding
Indomethacin, ketorolac	Avoid	Increased risk of upper gastrointestinal bleeding (more than other NSAIDs) and acute kidney injury
Skeletal muscle relaxants	Avoid	Poorly tolerated due to anticholinergic effects
Tramadol, SNRIs, SSRIs, TCAs	Use with caution	May increase risk of SIADH or hyponatremia

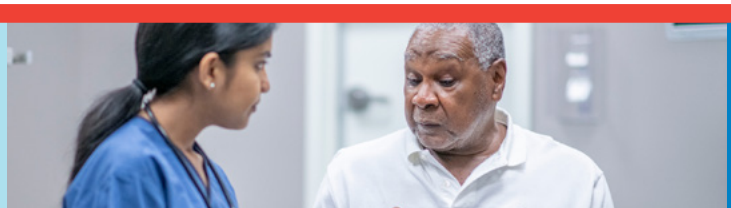
[A]Other than COX-2 selective agents (e.g., celecoxib)
Key: NSAID - nonsteroidal anti-inflammatory drug; PPI - proton pump inhibitor; SNRI - serotonin norepinephrine reuptake inhibitor; SSRI - selective serotonin reuptake inhibitor; TCA - tricyclic antidepressant; SIADH - syndrome of inappropriate antidiuretic hormone release.
Adapted from American Geriatrics Society. 2019 Updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc.* 2019; 67(4):674-694.doi:10.1111/jgs.15767

Acetaminophen is considered a first-line analgesic for older adults; however, drug clearance decreases with age, so reduce the maximum daily dose to 2,000 mg for patients over 80 years of age. Reduce doses for patients with an increased risk for hepatotoxicity as well, including those with heavy alcohol use, low body weight, and malnourishment.[14]

NSAIDs carry significant risk in the older adult, primarily gastrointestinal bleeding. Use these drugs at the lowest effective dose for the shortest time period, and avoid them altogether in patients with renal insufficiency, active upper gastrointestinal bleeding, platelet dysfunction, cardiac insufficiency, hyponatremia, hypovolemia, or hepatic impairment. NSAID use is not recommended in patients receiving full anticoagulation, and sustained use may reduce the cardioprotective effects of aspirin. When NSAIDs are used in the older adult, COX-2 selective agents (e.g., celecoxib) or gastroprotection with a proton pump inhibitor or misoprostol is recommended.

Use considerable caution with other adjuvant analgesics in older adults. See Table 14. Skeletal muscle relaxants have significant anticholinergic effects and need to be avoided. Gabapentinoids may be effective for neuropathic pain, but sedation and dizziness limit usefulness in this population, and slow titration to lower effective doses is required.

Finally, older adults are more susceptible to opioid-induced side effects, including respiratory depression, hypotension, delirium, constipation, and excessive sedation. With advancing age, opioids are associated with a prolonged half-life and prolonged pharmacokinetics. Especially in opioid-naïve patients, initial doses need to be low and then



titrated gradually to decrease the risk of overdose. When compared to dosing for a healthy adult, decrease the initial dose of an opioid by 25% in 60-year-old patients, and by 50% for 80-year-old patients; but administer them at the same intervals.

Table 14. Significant Drug Interactions in Older Adults

Interaction	Recommendation	Rationale
Opioids with benzodiazepines	Avoid	Increased risk of overdose
Opioids with gabapentinoids	Avoid unless transitioning from one therapy to another	Increased risk of severe sedation, including overdose
Other psychoactive drugs (e.g., antidepressants, antipsychotics, benzodiazepines, and sedative-hypnotics)	Avoid combinations, specifically combinations of 3 or more	Increased risk of falls and fracture
NSAIDs* and systemic corticosteroids	Avoid	Increased risk of upper gastrointestinal bleeding

*NSAID - nonsteroidal anti-inflammatory drug
Adapted from American Geriatrics Society. 2019 Updated AGS Beers Criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc.* 2019;67(4):674-694. doi:10.1111/jgs.15767

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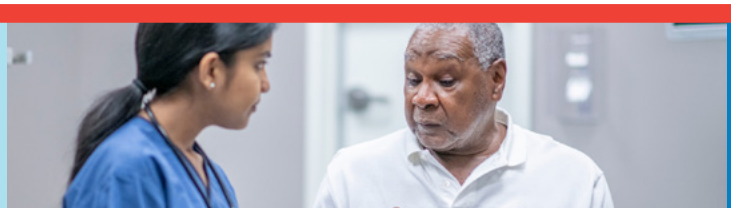

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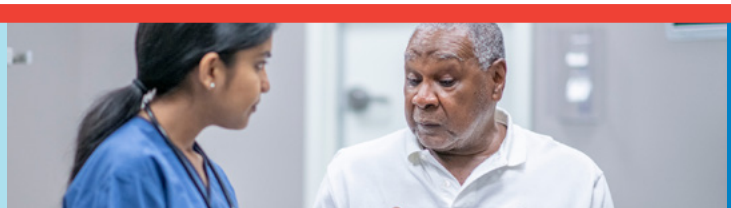

PAIN MANAGEMENT IN CHILDREN

PAIN MANAGEMENT IN CHILDREN

Key Points:

- Pediatric patients have unique age and developmental factors that must be taken into consideration during assessment and management of post-traumatic pain.
- A multimodal approach including local, regional, and systemic analgesic pharmacologic interventions is recommended to manage traumatic pain in children.

Appropriate assessment and management of pain is essential to minimize morbidity associated with untreated and undertreated pain in injured children. A comprehensive and systematic approach, taking into consideration age and developmental factors, is paramount. The American Academy of Pediatrics published statements regarding the assessment and management of acute pain in infants, children, and adolescents, including the relief of pain and anxiety in children within EMS systems.[1,2] In general, MMA is recommended, incorporating child life specialists and family members when appropriate, in conjunction with pharmacologic and nonpharmacologic measures.

Nonpharmacologic Pain Management

Virtual reality techniques are the best-studied nonpharmacologic strategies as a means of distraction following burn injury and routine burn care. A single-center, randomized trial of adolescents compared standard care, passive distraction, and virtual reality during burn care and found significant improvement in procedural pain using the virtual reality environment.[3] A single-center RCT of 54 hospitalized burn patients, aged 6 to 19 years, demonstrated improvement in pain scores and overall range-of-motion during physical therapy when using virtual reality compared to standard of care.[4]

Medical hypnosis helps patients focus their attention and accept a health care provider's suggestions to decrease pain and anxiety associated with painful procedures.[5] Although few studies in children are reported, one randomized, single-center, prospective study in 62 pediatric patients with burn injuries showed reductions in pre-dressing change anxiety, pain level, and procedural heart rate.[6]

Finally, physical strategies such as immobilization can improve pain related to musculoskeletal injury. Two single-center trials demonstrated that immobilization, as part of an MMA pain management strategy, improved pain scores and shortened time to return to activity.[7,8]

Pharmacologic Analgesia

Pharmacologic analgesia plays an essential role in the management of trauma-related pain in children. See Table 15. Multiple studies evaluated the effectiveness of acetaminophen, opioids, NSAIDs, and combinations on pediatric trauma-related pain. Most studies are related to acute musculoskeletal trauma, and great variability in agent and administration technique (e.g., oral, intravenous, inhalation, sublingual, etc.) is reported across studies. A recent systematic review of pediatric musculoskeletal injury in the ED, including eight studies of 1,169 children aged 3 to 18 years, showed a wide variability in administered analgesics, preventing the identification of an optimal analgesic strategy.[9]

Randomized prospective studies comparing NSAIDs and opioids (most commonly tramadol, codeine, and morphine) in children with traumatic bone injuries consistently demonstrated no difference in analgesia; but potentially more adverse drug reactions occurred in the patients who received opioids.[10-13] Avoid codeine and tramadol in children, specifically children under 12, as these agents are associated with an increased risk of death.[14]

Intranasal and nebulized short-acting analgesics (e.g., ketamine and fentanyl) are attractive options after acute injury to avoid IV placement. Both agents are effective analgesics, with similar pharmacokinetics and efficacy compared to IV opioid administration.[15-19] Of note, a Cochrane review reported that oral sucrose administration appears promising for reducing pain in infants and children under one year of age, particularly with respect to needle-induced pain.[1,20]

Regional Analgesia

In children, regional analgesia is commonly employed for surgical procedures to augment the effects of general analgesia.[21] While regional techniques were assessed in several studies,[22-25] and regional and local therapies have a role in the MMA management of acute traumatic pain in children, currently no comprehensive studies demonstrate definitive benefit.

Table 15. Selected Analgesics and Considerations for Use in Pediatric Patients

Medication	Dosing		Precautions (P), Contraindications (C), and Considerations[B]
	Maintenance Dose[A]	Maximum Suggested Dose/Duration[B]	
Acetaminophen	PO: 10-15 mg **per kg** q4-6h PR: 20-25 mg **per kg** q6h IV: 7.5-15 mg **per kg** q6h	PO: 75 mg **per kg** per day (4,000 mg per day) PR: 100 mg **per kg** per day (maximum 5 days) IV: 60 mg **per kg** per day (3,750 mg per day)	Liver dysfunction (P) Cardiac dysfunction (P) Avoid suspension and injectable products with ketogenic diet (C)
NSAIDs			
Ibuprofen	PO: 10 mg **per kg** q6-8h	40 mg **per kg** per day (400 mg per dose)	Renal dysfunction (C) Cardiac history (C) GI bleeding (C) Avoid suspension with ketogenic diet (C) Fracture (P)
Ketorolac	PO: 1 mg **per kg** q4-6h IV/IM: 0.5 mg **per kg** q6h	PO: 10 mg per dose; 40 mg per day IV/IM: 15 mg per dose Maximum 5 days of therapy regardless of route	
Skeletal Muscle Relaxants			
Methocarbamol	PO/IV: 15 mg **per kg** q8h	1,000 mg per dose; 4,000 mg per day	Sedating, especially with other CNS depressants Limit IV use to less than 3 days
Diazepam	PO: 0.1 mg **per kg** q6h IV: 0.05 mg **per kg** q4-6h	10 mg per dose; 40 mg per day	
N-methyl-D-aspartate (NMDA) Antagonists			
Ketamine	IN: 1.5 mg **per kg** IV/IM: 0.3 mg **per kg**	IN: 1 mL per nostril	Acute psychosis, CVA, cardiac decompensation (C) Dose based on ideal body weight if obese Dependence potential Monitor for emergence reactions

Table 15. Selected Analgesics and Considerations for Use in Pediatric Patients (Continued)

Medication	Dosing		Precautions (P), Contraindications (C), and Considerations[B]
	Maintenance Dose[A]	Maximum Suggested Dose/Duration[B]	
Opioids			
Fentanyl	IN: 1.5 mcg **per kg** IV: 1-2 mcg **per kg** q1h CI: 1-3 mcg **per kg** per hour	IN: 100 mcg per dose IV: 2 mcg **per kg** per dose (25-50 mcg) CI: 5 mcg **per kg** per hour	All opioids confer risk of addiction and life-threatening respiratory depression Extended-release preparations are not intended for acute pain Fentanyl may accumulate in lipid stores with prolonged use
Hydromorphone	PO: 0.03 mg **per kg** q4h IV: 0.015 mg **per kg** q3-6h CI: 0.003-0.005 mg **per kg** per hour	PO: 0.06 mg **per kg** per dose IV: 0.015 mg **per kg** per dose (1-2 mg) CI: 0.005 mg **per kg** per hour (0.2 mg per hour)	
Morphine	PO: 0.2 mg **per kg** q3-4h IV: 0.1 mg **per kg** q2-4h CI: 0.01 mg **per kg** per hour	PO: 0.5 mg **per kg** per dose (15-20 mg) IV: 2-10 mg per dose based on age CI: 0.04 mg **per kg** per hour	
Oxycodone	PO: 0.1 mg **per kg** q4-6h	5-10 mg per dose	

[A]Assumes opioid-naïve, age at least 6 months, and normal renal/hepatic function.
[B]The information listed in this table is intended to represent general dosing recommendations and adverse effect concerns and is not intended to be an extensive listing of all possible precautions, contraindications, and considerations.
Key: PO – oral; IM – intramuscular; IV – intravenous; IN – intranasal; CI – continuous infusion.

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PAIN MANAGEMENT IN PREGNANT PATIENTS

PAIN MANAGEMENT IN PREGNANT PATIENTS

Key Points:

- Pregnancy does not preclude treatment of pain after trauma. Untreated pain can have adverse consequences for both the mother and fetus.
- Nonpharmacologic pain management is preferred for the pregnant trauma patient.
- Minimize pharmacologic therapies when possible, and step-wise titration of medications known to be safe in pregnancy is recommended.

Pain management in the pregnant patient is complicated by the physiologic changes in the mother as well as the risks posed to the fetus by both pain and analgesia. Various structural changes occur in the pregnant women's body that predispose her to pain, in addition to the pain associated with trauma.[1] The pain management goal is to effectively treat the patient's pain while minimizing the risks to both the mother and fetus. Educating the patient and family regarding medication use and possible adverse effects, as well as realistic expectations for pain relief and function, is the foundation of pain management.[2,3]

Nonpharmacologic Pain Management

To assist with pain relief caused by traumatic injuries, several nonpharmacologic therapies can be used as in other populations. Heat and cryotherapy may assist with pain relief with minimal adverse effects for the mother or the fetus.[2] Use of a TENS device is safe in pregnancy. A recent Cochrane Review reported aromatherapy for labor pain management is not effective;[3] however, its use for non-labor pain may have an analgesic effect with minimal risk.[4]

Manual therapies such as physical and occupational therapy, osteopathic manipulative therapy, and acupuncture are generally considered safe during pregnancy, and they are commonly used for both acute nonobstetric and obstetric-related pain relief. Avoid therapies that could stimulate the cervix or uterus and cause induction of labor.[1,5]

Pharmacologic Analgesia

When determining whether to use pharmacologic analgesics, investigate and weigh the risks and benefits to both the patient and fetus. Severe and persistent pain ineffectively treated during pregnancy can result in depression, anxiety, and high blood pressure in the patient.[6] Many effective pharmacologic analgesics—notably NSAIDs and opioids—carry significant potential risk to the fetus within utero

exposure. Therefore, seek patient input and wishes from the pregnant trauma patient and integrate them into treatment decisions. Discuss the treatment goals and intended duration of therapy with the patient.

The FDA recently released the Pregnancy and Lactation Labeling Rule (PLLR) for prescription medications and biologics to help health care providers assess patient benefit versus risk, and to provide subsequent counseling to pregnant women and nursing mothers who need to take medication. The PLLR replaces the pregnancy letter categories of A, B, C, D and X with narrative summaries in three sections of the FDA label.[7]

- Section 8.1 describes use in pregnancy and includes a risk summary, clinical considerations and data, and any pregnancy exposure registry information.
- Section 8.2 describes medication use during lactation, and includes information on breastfeeding, the amount of drugs found in breast milk, and any anticipated effects on the infant.
- Section 8.3 includes information for females and males of reproductive potential, including pregnancy testing, contraception recommendations, and infertility risk.

All studies reviewed by the FDA on pain medications in pregnancy have potential design limitations; and at times the accumulated studies on a topic contain conflicting results that prevent the FDA from drawing reliable conclusions.[6] See Table 16.

Pregnancy-induced pharmacokinetic alterations can dramatically alter response to medications.[8] Changes in gastric pH, cardiac output, and intestinal

Table 16. Medications Generally Considered Safe (✓) to Use in Pregnancy for a Short Course

Medication	Route	First Trimester	Second Trimester	Third Trimester
Acetaminophen	Oral, rectal, IV	✓	✓	✓
Cyclobenzaprine	Oral	✓	✓	
Fentanyl	IV, intranasal	✓	✓	✓
Hydromorphone	Oral, IV	✓	✓	✓
Ketamine	IV, intramuscular		✓	
Lidocaine	Topical, regional (block)	✓	✓	✓
Methocarbamol	Oral, IV	✓	✓	✓
Morphine	Oral, IV	✓	✓	✓
Oxycodone	Oral	✓	✓	✓

Source: Courtesy of Michelle Barrett Caruso.

motility may alter oral analgesic absorption and efficacy. Due to changes in total body water, plasma concentration of hydrophilic drugs may decrease as distribution volume increases. Decreased plasma protein binding increases free (active) drug concentrations but may further increase drug distribution into tissue. Changes to the cytochrome P450 system (e.g., increased activity of CYP3A4, 2A6, 2D6, and 2C9 as well as decreased activity of CYP1A2 and 2C19) alter drug metabolism, which may increase risk of toxicity or decrease efficacy, depending on the analgesic administered. Finally, renally eliminated medications are affected by increases in the glomerular filtration rate by the first trimester. Consultation with an obstetrician or pharmacist is strongly recommended prior to administering medications to pregnant patients.

Nonopioid therapies considered generally safe to use during pregnancy include acetaminophen, topical lidocaine, and select skeletal muscle relaxants. Acetaminophen is considered the first-line pharmacologic therapy. While topical therapies are generally considered safe, the amount of drug absorbed from application varies by dose administered, duration of exposure, and site of application. While regional analgesia is highly desirable in pregnant patients, providers must administer with caution, as central neuraxial block may result in hypotension. Because the spread of local analgesic within the epidural/spinal space is greater, the initial dose should be decreased with subsequent titration as needed.[9]

Cyclobenzaprine and methocarbamol are considered low-risk therapy in pregnancy. Ketamine is inconsistently reported to cause dose-dependent uterine contractions and its use should be avoided in patients with pre-existing hypertension.[10] Tricyclic antidepressants, when used at therapeutic doses, do not appear to increase risk of birth defects. However, chronic or high-dose use, specifically near term, is associated with neonatal withdrawal; therefore, tapering of therapy within 3-4 weeks of delivery is recommended.[4]

Nonopioid analgesics to avoid during pregnancy include NSAIDs, most skeletal muscle relaxants, and anticonvulsants.[11] Use of NSAIDs in the first half of pregnancy increases the risk of miscarriage;[12] in the third trimester causes vasoconstriction of uterine arteries; and near term causes premature closure of the ductus arteriosus, oligohydramnios, and hemostatic abnormalities of the mother and newborn (e.g., neonatal intracranial hemorrhage). Carisoprodol use increases risk of oral clefts when used during the first trimester, and tizanidine can cause dose-related hypotension. Avoid anticonvulsants and antidepressants due to the risk of neural tube defects, mental deficiency, and craniofacial abnormalities. Gabapentin use specifically is associated with increased risk of preterm birth and low birth weight.[13]

Opioids for severe, persistent pain may be employed for a short course of treatment. However, risks from opioid treatment include the patient's

physiological dependence on opioids and neonatal opioid withdrawal syndrome (NOWS) in the newborn.[14] The risk of NOWS in the neonate can be reduced by employing short courses of opioids,[15] using shorter-acting formulations as compared to longer-acting or extended-release preparations,[16] and limiting their use late in pregnancy.[15] Tramadol use is discouraged due to a moderate increased risk of congenital malformations.[17]

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PAIN MANAGEMENT IN PATIENTS WITH DEPRESSION

PAIN MANAGEMENT IN PATIENTS WITH DEPRESSION

Key Point:

- Recognize that depression, anxiety, and other mood disorders are linked to acute and chronic pain due to injury.

Mood disorders and pain are linked, as each can potentiate the other. Prolonged acute pain after injury may lead to greater mood dysregulation.[1] Underlying depression, anxiety, and other mental health disorders are also associated with more severe pain after surgery[2] and pain interference after trauma.[3] Nearly one in five American adults is prescribed psychotropic medication,[4] and up to 36% of patients are prescribed psychotropics prior to TBI.[5] Abrupt discontinuation of psychotropic medications may cause withdrawal and is associated with increased psychiatric symptoms in hospitalized patients.[6] In general, restart psychotropic medications as soon as possible after admission. However, because psychotropic medications may increase the risk of injury, particularly due to falls in the older adult,[7] conduct a risk-benefit analysis of medication continuation in consultation with the patient's primary care provider or psychiatry.

One study with more than 4,000 orthopaedic trauma patients documented a history of depression in about 4% of them. Two-thirds of the patients with a documented depression history had a documented median delay of 24 hours (range 0–14 days) before their psychotropic medications were restarted, and overall the patients with a history of depression or anxiety had a 32% longer length of stay.[8] Patients with pre-injury depression are also more likely to develop PTSD symptoms after injury.[9]

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PAIN MANAGEMENT IN PATIENTS ON CHRONIC OPIOID THERAPY OR WITH OPIOID USE DISORDER

PAIN MANAGEMENT IN PATIENTS ON CHRONIC OPIOID THERAPY OR WITH OPIOID USE DISORDER

Key Points:

- Chronic opioid use increases the risk of trauma, length of stay, and likelihood of ICU admission following a traumatic event. On discharge, patients with opioid use disorder (OUD) are more likely to get opioid prescriptions of longer duration.
- Patients with untreated OUD presenting after a traumatic injury need treatment for withdrawal as well as acute pain. Inpatient initiation of OUD treatment is safe and effective.
- Patients presenting on agonist medication-assisted treatment for OUD (e.g., methadone or buprenorphine/naloxone need continuation of this treatment throughout hospitalization). Address acute pain as for any other patient, using MMA, including full-agonist opioids if necessary.
- Plan the transition from inpatient to outpatient care, either by communicating with the patient's existing health care providers or referring patients with newly diagnosed OUD to outpatient treatment facilities.

Over the past 15 years a marked increase in the use of prescription and nonprescription opioids means physicians of all specialties see more patients on chronic opioid therapy or with an OUD.[1,2] Chronic opioid use is particularly prevalent in patients presenting with traumatic injuries.[3] Between 4 and 5% of all adults in the U.S. use opioids regularly, yet 16-18% of patients presenting to a trauma center were taking opioids pre-injury.[4,5] The increased incidence of opioid mentions in ED admissions, an indicator of opioid use, far outpaced the increase in opioid prescriptions,[6] suggesting a concentration of high opioid users in the trauma population.

Impact on Patient Outcomes

In addition to hyperalgesia, opioid tolerance, and acute withdrawal, preinjury chronic opioid use is associated with multiple negative outcomes. A retrospective review of 4,352 consecutive adults admitted to a level 1 trauma center over one year found a significant increase in length of stay with lower levels of trauma severity among patients using opioids pre-injury.[4] Patients using opioids prior to admission require more operative interventions, are more likely to be admitted to the ICU, have a longer length of stay, and experience more major complications and unplanned readmissions.[2,5] This risk appears to be greater in patients using illicit opioids (e.g., heroin) versus

those taking prescription opioids for chronic pain, as well as those using multiple substances (e.g., opioids with benzodiazepines or alcohol).[5]

Additionally, patients with pre-injury SUD are more likely to get longer opioid prescriptions postdischarge,[7] increasing their risk of subsequent complications.

Assessment Considerations

To provide quality care, recognition and diagnosis of OUD is vital for patients presenting to a trauma center with an untreated OUD. Routinely ask all patients about prescription and nonprescription drug use when feasible on admission to hospital.

No guidelines exist for routine drug testing of patients seen for traumatic injury, and the practice is variable among trauma centers.[8] One study suggests that patients activating a trauma alert or trauma code on admission should have routine blood alcohol and urine drug screening.[8] Clinically, heightened tolerance to opioid analgesics or pain behavior suggesting hyperalgesia may indicate an underlying OUD, and these patients require further screening. Consider using the screening brief intervention, referral to treatment (SBIRT) service developed by the Substance Abuse and Mental Health Administration (SAMHSA) in 2003. SBIRT was demonstrated to be beneficial for patients with SUD.[9]

Management of Patients on Prescribed Opioid Therapy for Chronic Pain

Generally, continue prescribed opioid therapy for patients with chronic pain throughout hospitalization; however, consider the possibility that opioid use contributed to the patient's traumatic event. Verify the prescription and use of the medication as soon as possible with either the primary prescriber or through a prescription drug monitoring program.

Management of Patients with Untreated OUD

The initial management of a patient with untreated OUD presenting with a traumatic injury involves focusing on treating symptoms of opioid withdrawal and treating acute pain associated with the injury. The amount of opioid required will depend on the severity of the OUD and the severity of the injury. An IV opioid via a patient-controlled analgesia (PCA) pump, or short-acting oral opioid are both suitable for treating acute pain and addressing opioid withdrawal. PCA may be safer and easier to titrate in the initial treatment phase, if the patient is able to use the device. Adjunctive drugs, including clonidine, gabapentin, and ketamine may help pain management.[10]

Consider prompt referral to inpatient addiction medicine services even in the early phase of trauma care. Inpatient initiation of OUD treatment was found to be feasible and effective,[11] leading to better engagement with outpatient

treatment and reduced ED admissions.[11,12] SAMHSA previously reported that a DATA 2000 waiver (i.e., X-license) is not required for health care providers to administer or dispense buprenorphine or methadone when patients with underlying OUD are admitted to the hospital for a different primary medical problem.[13]

Management of Patients Receiving Treatment for OUD

The treatment of OUD with opioid agonist therapy, typically methadone or buprenorphine, is effective, and it is increasingly used in the outpatient setting.[12] Subsequently health care providers in acute care and trauma medicine are increasingly placing patients on medication-assisted treatment (MAT) for OUD. MAT may also be referred to as medication for OUD or pharmacotherapy for OUD. Few studies have examined the management of patients on MAT for OUD in the context of trauma. Nevertheless, the principle of adequately treating acute pain remains, both to control the clinical sympathetic response and to provide good medical care to patients who are suffering. Use of MMA is recommended. Involve patients in decision-making, specifically regarding the use of new opioids that may complicate their underlying OUD.

As a general principle, patients on MAT with methadone need to continue their treatment throughout the period of acute pain, with confirmation of the methadone dose by the outpatient health care provider. This will prevent withdrawal and help stabilize the behavioral and psychiatric components of OUD.[14] However, this is likely to be inadequate to treat moderate to severe acute pain.[15] Treat all patients on MAT with acute pain with an MMA approach, including pharmacological and nonpharmacological modalities. Patients with moderate to severe pain may require further opioid analgesia, which can be provided as IV PCA or as an oral short-acting full mu agonist on an as-required basis. Given the unique pharmacology of methadone, specifically shorter analgesic effect (vs. suppression of withdrawal symptoms), it is reasonable to divide the total daily dose and administer every 8 to 12 hours. Do not titrate chronic MAT for acute pain analgesia.

Patients on buprenorphine therapy present a unique challenge, as the drug is a high-affinity partial agonist at the mu receptor,[16] which theoretically limits the effect of full mu agonists. A recent retrospective analysis of surgical patients on transdermal buprenorphine found patients required significantly higher doses of opioid in the postoperative period despite receiving more opioids intraoperatively.[17] However, no other adverse outcomes were reported, and continuation of buprenorphine treatment throughout the admission is becoming the standard of care in many centers. Similar to methadone, buprenorphine doses can be divided and administered every 8 to 12 hours to improve analgesia. Discontinuing buprenorphine on admission and switching to full-agonist opioids was reported to be difficult due to persistent opioid tolerance,[17] and this

complicates discharge planning due to the need to convert back to MAT at some point.[18] A potential, uncommon third option is to switch from buprenorphine to methadone on admission with acute pain. Methadone at 30-40 mg per day will manage the baseline opioid requirement and help prevent withdrawal for most patients, and it may allow full mu agonists such as morphine, oxycodone, and hydromorphone to provide additional pain relief more predictably.[12] Again, the eventual transition back to buprenorphine may be challenging with this approach.

Intramuscular sustained-release naltrexone use represents a particular challenge, as the highly potent antagonist severely limits the analgesic effect of most opioids. Consultation with a pain specialist is advised because little data exist to guide analgesic therapy, and patients may require significantly higher opioid doses with close monitoring.

Coordination with Chronic Pain or Primary Care Provider

Coordination of care between trauma and chronic opioid/MAT prescribers improves patient compliance.[19] Notify chronic care providers as soon as possible when a patient is hospitalized. In addition to confirming pre-admission opioid use, care coordination with outpatient providers may validate missed appointments (e.g., for patients in an opioid treatment program), aid the transition back to a chronic regimen, and prevent unanticipated confusion regarding postdischarge urine drug screens. Connect patients with newly identified OUD with outpatient care, ideally prior to hospital discharge.[20] Carefully plan the patient's acute analgesic needs after discharge with the patient's chronic provider, including clear expectations for prescribing responsibilities, and communicate this plan to the patient.

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PAIN MANAGEMENT AT END-OF-LIFE

PAIN MANAGEMENT AT END-OF-LIFE

For a complete discussion of palliative and end-of-life care, see TQIP Palliative Care Guidelines.

Key Points:

- Withdrawal of life-sustaining treatment is a coordinated process that must account for the needs of family, caregivers, and patients.
- Integration of palliative and trauma care can assist patients and families, regardless of outcome.

Up to 20% of trauma patients admitted to the ICU die; however, most patients wish to die at home.[1,2] Because pain management is an essential component to end-of-life care, it needs to be a primary therapeutic focus. This requires specific knowledge of pharmacologic treatments, specifically the impact of end-organ failure, as well as behavioral, social, and communication strategies from palliative care services.

Coordinate the withdrawal of life-sustaining treatment, accounting for the needs of the family, caregivers, and patient. Defined policies and procedures are useful to guide this process—to minimize the patient's pain, discomfort, and dyspnea in their final moments. Additional goals include creating a peaceful environment with ample space for the family to process grief. Key principles are as follows:

- Remove all unnecessary equipment, monitoring devices, and restraints from the patient room.
- Silence all alarms.
- Discontinue noncomfort medications, artificial nutrition, or intravenous lines.
- Provide tissues, water, and comfortable chairs for the family members.
- Adjust the bedrails/bed height to enable family-patient touching or handholding.
- Discuss the dying process with the family and describe what they are likely to see or hear.
- Allow time for any rituals, especially if death is likely to be imminent once life-sustaining treatment is discontinued.

Principles of Medication Management

Precede the ventilator withdrawal with the cessation of neuromuscular blockade, and administer appropriate medications for sedation and analgesia, and for the prevention and treatment of dyspnea. See Table 17. Often the patient is simply extubated after suctioning because oral and respiratory secretions can cause stridor, airway obstruction, or the "death rattle." Head of bed elevation, oral suctioning, and transdermal scopolamine can reduce secretions. Patients and families find dyspnea very distressing—reassure them

it will be treated and managed. Opioids are the first-line treatment for dyspnea, but benzodiazepines may be added in small, titrated doses for refractory cases. Describing expected respiratory changes as the patient nears death is helpful to manage family and caregiver discomfort.

Drugs and Dosages

In general, continue analgesic and anxiolytic medications at the current rate, assuming the patient is comfortable and calm. Doses may be increased, as needed, as frequently as every 15 minutes. Rescue analgesic doses of 50-100% of the current hourly rate can be given as a single bolus.

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Table 17. Suggested End-of-Life Drugs and Dosages for Opioid-Naïve Patients

Indication	Maintenance Dose		Special Considerations
	First Line	Second Line	
Analgesia	Morphine 4 mg IV q15min PRN OR Fentanyl 100 mg IV q15min PRN	Morphine 2-8 mg/hr based on previous requirement OR Fentanyl 50-200 mcg/hr based on previous requirement	• Consider fentanyl or hydromorphone infusion if morphine is contraindicated • Titrate infusion every 15 minutes to comfort • Ensure prior analgesic medications (or equivalent) are continued
Dyspnea	Morphine 5 mg PO/SL q4hr with 2.5 mg PRN OR Morphine 2.5 mg IV q15min PRN	Benzodiazpine (e.g., midazolam or lorazepam) for anxiety	• Other opioids may be considered, but limited data exists • Do not use benzodiazepines for treatment of dyspnea that is not due to anxiety
Anxiety	Lorazepam 1 mg IV q1hr PRN OR Midazolam 4 mg IV q30min PRN	Midazolam 2 mg/hr	• Consider psychotherapy and complementary therapies • Ensure prior psychiatric medications (or equivalent) are continued
Delirium/ hallucinations	Haloperidol 0.5-1mg IV q1hr PRN	Second-generation antipsychotic (e.g., olanzapine)	• Treat underlying cause • May consider benzodiazepine infusion short-term for severe symptoms

Source: American College of Surgeons, TQIP Palliative Care Best Practice Guideline.

IMPLEMENTING THE BEST PRACTICES GUIDELINE FOR ACUTE PAIN MANAGEMENT IN TRAUMA PATIENTS

IMPLEMENTING THE BEST PRACTICES GUIDELINE FOR ACUTE PAIN MANAGEMENT IN TRAUMA PATIENTS

Key Points:

- Trauma medical directors (TMDs), trauma program managers (TPMs), trauma liaisons, registrars, and staff have a leadership role in implementing and supporting pain management; and in implementing and monitoring compliance of the pain management best practices guideline (BPG).
- Implementing the pain management BPG starts with a stakeholder workgroup that receives its directives from the trauma medical director and the trauma operations committee.
- The workgroup is charged with completing a gap analysis to identify the priorities for developing or revising the trauma center's pain management guideline, identifying the priorities, and developing an educational plan to introduce the guideline.

Implementing a trauma center BPG begins with the TMD, TPM, the trauma liaisons, and trauma program staff as leaders and change agents. These individuals are responsible for the oversight, management, and continuous commitment to improving care within the trauma center and the trauma system, regardless of trauma center designation level. They define the leadership structure, culture, and implementation processes for BPGs that foster stakeholder engagement. These leaders define the following:

- The pain management guideline workgroup, comprised of champions and stakeholders
- The workgroup leader
- The goals and timelines for completion of a gap analysis focused on the trauma center's pain assessment and management practices and the Best Practices Guideline for Acute Pain Management in Trauma Patients
- The reporting structure for the pain management guideline workgroup

The pain management guideline workgroup is charged with identifying gaps by comparing current practices to those recommended in the BPG.[1] This gap analysis identifies opportunities to align the trauma center's pain management practices with the Best Practices Guideline for Acute Pain Management in Trauma Patients. This workgroup, in conjunction with the trauma center's operations committee, establishes the priorities for changes. Progress reports regarding the completion of these identified tasks are provided to the trauma operations committee. See Table 18 for examples of gap assessment tools.

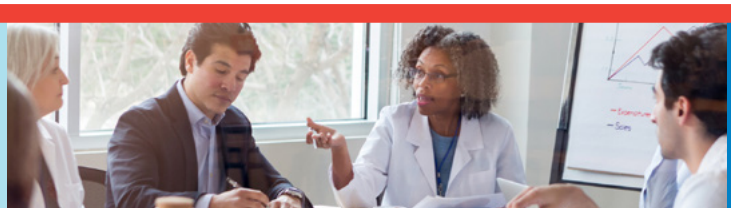
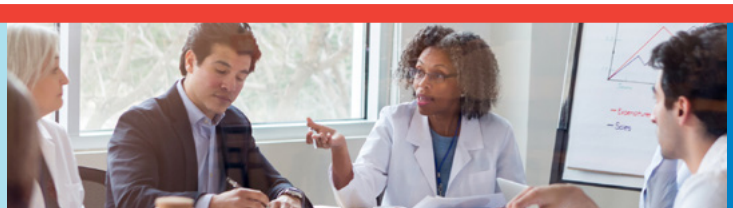


Table 18. Pain Management Gap Analysis

Pain Management Review	Met	Partially Met	Unmet	Priority	Comments
Regulatory requirements and recommendations are met and are consistent with the patient's age, condition, and ability to understand.					
Pain management recommendations are in place and contemporary.					
Pain management guidelines are in place and consistent with the patient population needs.					
Pain assessment documentation is consistent for patient population's pain level assessment.					
Pain assessment and reassessment expectations are defined.					
Nonpharmacological strategies are integrated into the pain management guidelines as appropriate for the patient's phase of care and level of understanding.					
Pain management guidelines are inclusive of all phases of care from pre-hospital, resuscitation and evaluation, procedural, perioperative, postoperative, intensive care, general unit, and discharge planning.					
Pain management guidelines are inclusive of regional and extremity blocks.					
Pain management guidelines for specific patient populations are integrated into the overall pain management guidelines to include—but not limited to—pediatrics, pregnancy, geriatrics, multisystem injured, chronic opioid therapy patients, and palliative care pain management.					
Documentation guidelines are specific to the patient's age, condition, and level of understanding.					
Measures to address the prescription drug monitoring program (PDMP)[2] and patient safety considerations are integrated into the pain management guideline.					



The next step is to revise or develop the trauma center's pain management guidelines for the phases of care. The pain management BPG is reviewed and approved by the trauma operations committee and the TMD. The operations committee is responsible for dissemination and communication of the revised pain management guidelines to individuals who participate in trauma care.

After revising or developing the trauma center's pain management guidelines, the pain management guideline workgroup's next priority is development of an educational plan to introduce the new guidelines to all stakeholders. This educational plan outlines the expectations for the various health professional roles involved in pain assessment and management, as well as the specific tasks associated with assessment, documentation, interventions, and reassessment.

The BPG implementation date is determined as the workgroup completes the pain management guidelines and develops the educational plan. The performance improvement and outcome measures to monitor compliance of the pain management guidelines are defined prior to implementation.

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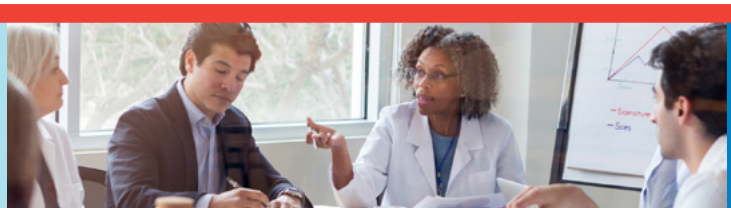

RECOMMENDED TRAUMA PERFORMANCE IMPROVEMENT GUIDELINE INTEGRATION

RECOMMENDED TRAUMA PERFORMANCE IMPROVEMENT GUIDELINE INTEGRATION

Key Points:

- Trauma will have a defined representative (or representatives) integrated into the facility's pain management guideline development process to ensure all populations served by the trauma center are addressed.
- The trauma center will provide a pain management service or resource to serve as a consultant expert to the trauma service.
- Pain management guidelines are integrated into the Trauma Performance Improvement and Patient Safety Plan to monitor compliance, patient outcomes, and documentation recommendations.
- Pain documentation is standardized and consistent to foster continuity of care.
- Discharge planning will integrate measures to include the prescription drug monitoring program (PDMP) to ensure that specific regulatory and patient safety initiatives are addressed.

The trauma program will have a designated representative to participate in the development of the facility's pain management guideline to ensure that the guidelines meet the needs of the trauma patient population managed in the trauma center. This designated individual serves as the conduit between the pain management guideline development and the trauma operations committee. This ensures that all phases of care and all trauma populations are recognized and addressed in the pain management guideline.

The trauma center will have a pain management resource available to serve as a consultant to assist with pain management decisions and discharge planning processes. This may be a formal pain management service, a member of the pharmacy team, or the identified trauma liaison to the pain management committee.

The trauma operations committee and the appointed trauma representative will define the aspects of the pain management guideline to be integrated into the trauma performance improvement (PI) process, and will develop a reporting structure for the trauma operations committee. See Table 19. These trauma PI recommendations are applicable to trauma activations and trauma admissions. The pain assessment and documentation standards need to remain consistent and appropriate for the patient when possible.

The pain assessment and management documentation tools are consistent through the phases of trauma care to ensure continuity of care. This is addressed in the guideline, and changes are reviewed through the trauma operations committee.

The trauma service will integrate the PDMP processes and the prescription drug abuse (PDA) program into the discharge planning as a patient safety initiative. The trauma center needs to follow state guidelines regarding PDMP and PDA.

Table 19. Trauma Center Performance Improvement Recommendations and Outcome Measures

Trauma Center PI Recommendations	Outcome Measure	Integrated into Trauma Center PI Process
Trauma center will have a pain management resource available as a consultant for trauma care. This may be a formal pain management service, a representative from pharmacy, or the identified liaison from the trauma program.	This resource is identified and available for consultation.	
TMD and TPM define elements of pain management integrated into the trauma PI process. NOTE: the trauma program may follow the facility's recommendations or develop specific events for review.	Evidence of integration into the trauma PI process.	
Documentation standards are consistent through the phases of trauma care to ensure continuity of care.	Documented evidence of consistency exists and is integrated in the EMR.	
The trauma program has integrated the recommendations regarding State Prescription Drug Monitoring Program (PDMP) and Prescription Drug Abuse (PDA) Policy, and incorporated them into the discharge planning process as outlined by regulatory guidelines.	Discharge planning has documented evidence of compliance.	
A protocol exists for multimodal analgesia (MMA) regimens and limited duration prescriptions.	Discharge planning has documented evidence of compliance.	

ACRONYMS

APAP – acetaminophen

BIS – bispectral index
BPG – best practice guideline
BPS – Behavioral Pain Scale

CAPA – Clinically Aligned Pain Assessment
CAS – color analog scale
CBT – cognitive behavioral therapy
CDC – Centers for Disease Control and Prevention
CI – contraindications
CNS – central nervous system
COX – cyclooxygenase enzyme
CPOT – Critical Care Pain Observation Tool
CVA – cerebrovascular accident

DESS – Echelle Douleur Enfant San Salvadour
DVPRS – Defense and Veterans Pain Rating Scale

ED – emergency department
EMR – electronic medical record
EMS – emergency medical services

FDA – U.S. Food and Drug Administration
FLACC – face, legs, activity, cry, consolability pain assessment tool
FPS – Functional Pain Scale

HIFU – high-intensity focused ultrasound

ICP – intracranial pressure
ICU – intensive care unit
IV – intravenous

LAST – local anesthetic systemic toxicity

MAT – medication-assisted treatment
MMA – multimodal analgesia

NOWS – neonatal opioid withdrawal syndrome
NCCPC-PV – Non-Communicating Children's Pain Checklist Postoperative Version
NSAID – nonsteroidal anti-inflammatory drug
NRS – numeric rating scale

OTA – Orthopaedic Trauma Association
OUD – opioid use disorder

P – precautions
PAINAD – Pain assessment in advanced dementia
PCA – patient controlled analgesia
PDA – prescription drug abuse
PDMP – prescription drug monitoring program
PI – performance improvement
PLLR – Pregnancy and Lactation Labeling Rule
PPI – proton pump inhibitor
PRN – when necessary (pro re nata)
PTSD – post-traumatic stress disorder

RCT – randomized controlled trial

SAMHSA – Substance Abuse and Mental Health Services Administration
SBIRT – screening brief intervention, referral to treatment
SIADH – syndrome of inappropriate antidiuretic hormone
SMR – skeletal muscle relaxant
SNRI – serotonin-norepinephrine reuptake inhibitors
SOS – Stopping Opioids after Surgery
SSRI – selective serotonin reuptake inhibitor
SUD – substance use disorder

TBI – traumatic brain injury
TCAs – tricyclic antidepressants
TENS – transcutaneous electrical nerve stimulation
TMD – trauma medical director
TPM – trauma program manager

UGNB – ultrasound-guided nerve blocks
U.S. – United States

VAS – visual analog scale
VR – virtual reality
VTE – venous thromboembolism

Appendix A: Doloplus-2 Scale

DOLOPLUS-2 SCALE

BEHAVIOURAL PAIN ASSESSMENT IN THE ELDERLY

NAME : Christian Name : Unit :

Behavioural Records

		DATES			
SOMATIC REACTIONS					
1• Somatic complaints	• no complaints	0	0	0	0
	• complaints expressed upon inquiry only	1	1	1	1
	• occasionnal involuntary complaints	2	2	2	2
	• continuous involontary complaints	3	3	3	3
2• Protective body postures adopted at rest	• no protective body posture	0	0	0	0
	• the patient occasionally avoids certain positions	1	1	1	1
	• protective postures continuously and effectively sought	2	2	2	2
	• protective postures continuously sought, without success	3	3	3	3
3• Protection of sore areas	• no protective action taken	0	0	0	0
	• protective actions attempted without interfering against any investigation or nursing	1	1	1	1
	• protective actions against any investigation or nursing	2	2	2	2
	• protective actions taken at rest, even when not approached	3	3	3	3
4• Expression	• usual expression	0	0	0	0
	• expression showing pain when approached	1	1	1	1
	• expression showing pain even without being approached	2	2	2	2
	• permanent and unusually blank look (voiceless,staring, looking blank)	3	3	3	3
5• Sleep pattern	• normal sleep	0	0	0	0
	• difficult to go to sleep	1	1	1	1
	• frequent waking (restlessness)	2	2	2	2
	• insomnia affecting waking times	3	3	3	3
PSYCHOMOTOR REACTIONS					
6• washing &/or dressing	• usual abilities unaffected	0	0	0	0
	• usual abilities slightly affected (careful but thorough)	1	1	1	1
	• usual abilities highly impaired, washing &/or dressing is laborious and incomplete	2	2	2	2
	• washing &/or dressing rendered impossible as the patient resists any attempt	3	3	3	3
7• Mobility	• usual abilities & activities remain unaffected	0	0	0	0
	• usual activities are reduced (the patient avoids certain movements and reduces his/her walking distance)	1	1	1	1
	• usual activities and abilities reduced (even with help, the patient cuts down on his/her movements)	2	2	2	2
	• any movement is impossible, the patient resists all persuasion	3	3	3	3
PSYCHOSOCIAL REACTIONS					
8• Communication	• unchanged	0	0	0	0
	• heightened (the patient demands attention in an unusual manner)	1	1	1	1
	• lessened (the patient cuts him/herself off)	2	2	2	2
	• absence or refusal of any form of communication	3	3	3	3
9• Social life	• participates normally in every activity (meals, entertainment, therapy workshop)	0	0	0	0
	• participates in activities when asked to do so only	1	1	1	1
	• sometimes refuses to participate in any activity	2	2	2	2
	• refuses to participate in anything	3	3	3	3
10• Problems of behaviour	• normal behaviour	0	0	0	0
	• problems of repetitive reactive behaviour	1	1	1	1
	• problems of permanent reactive behaviour	2	2	2	2
	• permanent behaviour problems (without any external stimulus)	3	3	3	3
	SCORE				

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