Trauma Reports

EVIDENCE-BASED MEDICINE FOR THE ED

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Pain Control in Trauma Patients

Regardless of hospital trauma level designation, every emergency department (ED) manages patients with traumatic injury and needs to address the pain and discomfort that accompanies it. Pain control recently became a priority for the Joint Commission, with an emphasis on measures to overcome barriers with hospitals to facilitate appropriate pain management strategies. In addition, pain control allows earlier patient mobilization, decreases incidence of DVT/PE, and decreases pulmonary complications.

Adequate pain control is a necessity in the trauma population. Although pain control is straightforward in minor to moderate trauma, ED staff have been found to significantly under-treat pain in all patients.[2] In the moderate to severe trauma population, pain control becomes more complicated, as it must be balanced against potential hemodynamic instability and the frequent need for neurological reassessment in those patients with head injuries. An increasing proportion of trauma involves the geriatric population, in whom complex co-morbidities abound, and approaches to pain control should be altered in these situations.

This article reviews the current pain control recommendations in the moderate to severely injured trauma population. Many of the medication classes addressed are well-known to practitioners, but will be revisited with special emphasis on their use and potential contraindications in the trauma population. Newer applications and adjuncts that may help control pain with less risk and better outcomes will also be discussed. This article will present a cohesive approach to what used to be an often-overlooked but important aspect of trauma critical care.

—The Editor

Introduction

Trauma is a frequent ED presentation, accounting for 37 million visits annually. Although most trauma patients are discharged home with what would be considered mild to moderate injuries, 2.6 million patients are admitted as inpatients annually. In 2000, traumatic injury resulted in a loss of $406 billion from not only health care costs, but also lost productivity.[3] Although much of this cost and lost productivity is unavoidable, there is growing evidence and consensus that adequate analgesia in both the immediate and long-term post-injury period may positively impact these outcomes, based on data from military research examining the long-term outcomes of injured personnel.[4]

Accounting for all ED encounters, pain represents more than half of the presenting complaints for ED visits.[5] Pain, described as an unpleasant sensory and emotional experience associated with actual or perceived tissue damage, often starts with traumatic cellular damage, although inflammatory mediators can be released by the immune system without injury. The subsequent swelling and inflammation that follows injury further causes increased pain receptor stimulation until nerve fibers in the area reach a certain threshold and fire.

Myelinated A delta nerve fibers carry localized and sharp thermal and mechanical impulses to the spinothalamic tract. Unmyelinated C fibers carry achy or throbbing, dull sensations to the spinal cord, brainstem, and thalamus that are poorly localized. The A beta fibers modulate the number and intensity

Executive Summary

- Poor pain control has been correlated with a catabolic stress response as well as increased incidences of venous thromboembolic events, pulmonary complications, and immunosuppression.
- A recent meta-analysis of 8 trials (922 patients) found that administration of opioid analgesics as part of the diagnostic process for patients with acute abdominal pain prior to a diagnosis did not increase the risk of treatment errors. It did, however, significantly improve patient pain control when compared to placebo.
- In the young, healthy population, NSAIDs can be appropriate first-line agents for mild to moderate pain. In the geriatric population, if NSAIDs must be used, the lowest effective dose for the shortest amount of time is suggested.
- In cases of multiple rib fractures in which contraindications to epidural catheters exist (vertebral fractures, profound hypotension), intercostal nerve blocks can be useful.

of impulses sent up the spinal tracts through inhibition of the A delta and C fibers. Intermittent or short-term firing can occur without sequelae, but chronic stimulation leads to changes in firing potential and creates feedback loops via A beta fibers that may ultimately cause chronic pain.

The two major types of "pain" are the localized soft-tissue or bony pain that often accompanies penetrating or blunt trauma, and the ill-defined neuropathic pain that can occur from proximal nerve or spinal cord root injury (i.e., stingers). Neuropathic pain often is not exacerbated by movement of a body part unless traction is put on the injured nerve. As discussed later, traditional pain medications are not fully effective for neuropathic pain.

Alert and verbal patients will either state they have pain or will volunteer such information when asked (and should be asked frequently),[6] depending on ethnic background or the state of the patient-nurse relationship. Initial pain assessment and frequent reassessment (every 15 to 30 minutes, depending on the degree of injury) is required for adequate analgesia. In patients who are intubated or have altered mental status, the only clinical indicators of pain may be tachycardia, tachypnea, or hypertension. Improvement in any of these findings after pain medication may be the only guide for analgesia in this subset of patients.

Intractable pain or pain out of proportion with the physical exam after either blunt or penetrating trauma is worthy of special mention, particularly in extremities that are susceptible to compartment syndrome. Pain is often the earliest and sometimes only indication of an evolving compartment syndrome, as pallor and decreased pulses are late and ominous findings. Further evaluation of suspected compartment syndrome consists of frequent re-evaluation and, ultimately, is excluded by a compartment pressure that is less than 10 mm Hg in adults and children.[7] Similarly, severe abdominal pain not fully explained by physical exam should prompt concern for ischemic bowel, either from a mesenteric hematoma or arterial dissection.

In the past few decades, not only has the array of intravenous analgesia expanded, but other pain control adjuncts, such as peripheral nerve blockade, have become more readily available. The focus of this article is to review well-known analgesics, introduce more recent modalities, and to suggest a multifaceted approach to pain control in the trauma population. Although mild to moderate pain control will be briefly addressed, this article will center on control of moderate to severe pain stemming from acute trauma.

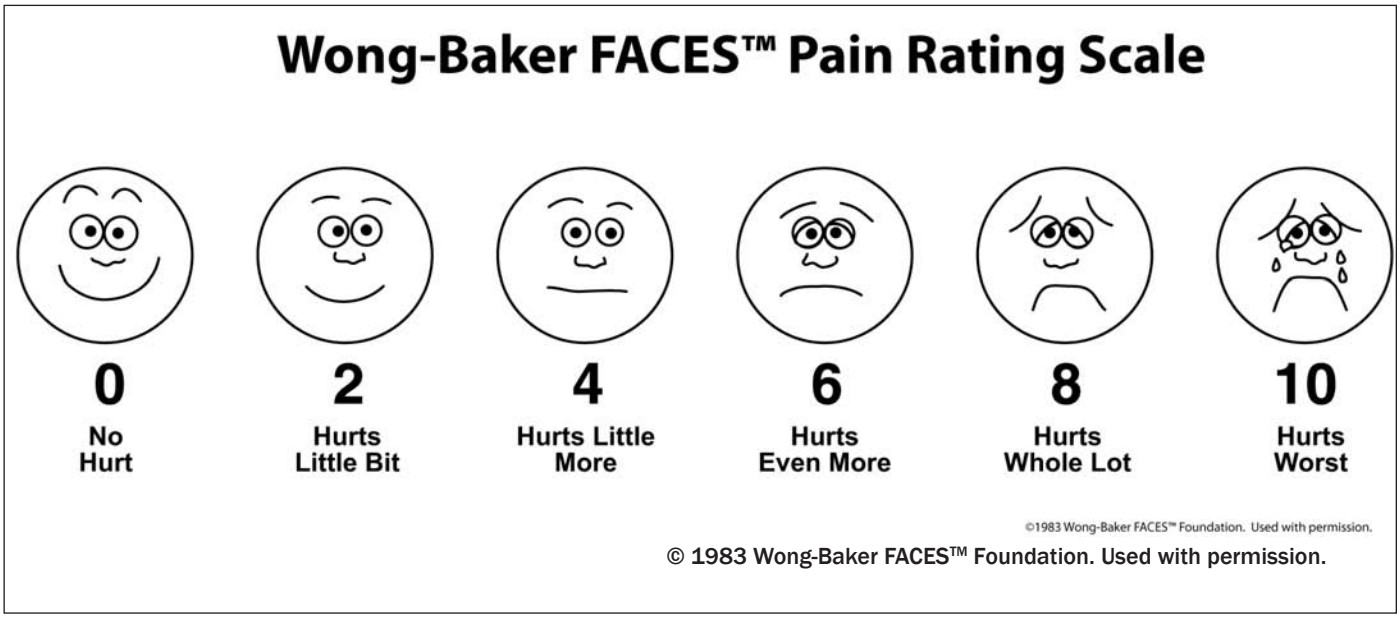
Table 1. Pain Control

Positive Effects
• Earlier patient mobilization
• Decreased neuroendocrine side effects of injury
• Slightly decreased cardiac complications
• Decreased incidence of DVT/PE
• Decreased pulmonary complications
Poor Pain Control Associated With:
• Increased incidence of chronic pain syndromes
• Post-traumatic stress disorder
• Increased morbidity and mortality

Why Analgesia in the Trauma Population Is Important

Inadequate pain control has received much attention in the ED and critically ill trauma patient populations. Poor pain control has been correlated with a catabolic stress response as well as increased incidences of venous thromboembolic events, pulmonary complications, and immunosuppression.[4,8] (*See Table 1.*)

Figure 1. Wong-Baker FACES™ Pain Rating Scale, One Commonly Used Pain Rating Scale



Adequate pain control in the ED setting has been associated with higher patient satisfaction and patient compliance,[9] although there are data suggesting the quality of analgesia provided in an ED cannot be inferred from patient satisfaction surveys.[10] (*See Table 1.*) The release of the new pain assessment and management compliance standards from the Joint Commission[1] have facilitated improvement in pain assessment and pain control delivery.[11]

Despite findings that suggest aggressive analgesia is imperative, pain control in the pre-hospital setting through hospital discharge has been described as inadequate.[12] Recent studies suggest the pre-hospital setting is one area in which adequate analgesia is particularly lacking in both the adult[13,14] and pediatric populations.[15] Inadequate analgesia continues once that patient arrives in the ED setting,[16] attributed to, among other causes, a lack of quality management programs that evaluate pain management, clinician attitudes toward opioid analgesics (i.e., drug-seeking behavior and addiction), concerns about opioid safety, and cultural or gender differences in pain assessment and reporting.[17] In discharged patients, inadequate analgesia continues, as 20% of patients, even those with a documented bone fracture, did not receive an analgesic prescription.[18] Factors associated with inadequate analgesia are older age,[11,19] minority race[20] and ethnicity,[21,22] and trauma.

One of the most contentious subjects concerning pain control in any setting is the ability to quantify the severity of the pain and track the patient's response to treatment. This is most often done through a pain score (*see Figure 1*), comprised of several illustrations of faces that represent varying degrees of discomfort. The use of imaging rather than text allows children and non-English-speaking patients to rate their pain severity. A 0–10 visually enlarged laminated numerical rating system has been found to be superior to written scales in the critically ill patient subgroup.[23] Assessing pain and trending its response to treatment gets more complicated in the elderly population or those who have cognitive impairment.[24] Frequent reassessment by physicians and nurses has been found to be a key determinant in adequately treating pain.

Opiates

Although most drugs in the opiate class are no longer derived from the opium poppy (*Papaver somniferum*), the mu pain receptor is the site of action for both organic and synthetic agents. These receptors are present in both the brain and in the dorsal horn of the spinal cord, as well as the intestines (the cause of constipation that accompanies narcotic usage). Narcotics are the mainstay for control of moderate to severe pain because of their potent efficacy. They are classified as Schedule II drugs under the Controlled Substances Act. Use of a protocol-driven approach that incorporates reassessment is particularly efficacious.[28,29]

The quintessential opiate is morphine sulfate, which serves as the gold standard for analgesia. Intravenous dosing at 0.1 mg/kg for analgesia is the classic teaching, but the clinical effectiveness of this dose has been called into question,[25] with dosing around 0.15 mg/kg appearing to be more effective.[26] An approximate equivalent to morphine[27] is intravenous hydromorphone at 0.015 mg/kg that has been found to be effective for moderate to severe pain, preferably by the intravenous route rather than by mouth.

Table 2. Equianalgesic Dosing of Commonly Used Opiates

Opioid	Acute Equianalgesic Dose (mg) Oral	Parenteral
Morphine	30 (acute)	10
Codeine	120	60
Hydrocodone	15	–
Fentanyl	–	0.1
Hydromorphone	7.5	1.5
Levorphanol	4	2
Oxycodone	20	–
Oxymorphone	–	1
Meperidine	Not recommended	Not recommended

Adapted from: Ashburn MA. Principles of analgesic use. Treatment of Acute Pain and Cancer Pain, American Pain Society 2003 and AHCPR.

The intravenous route does not ensure adequate analgesia, as poor analgesic outcomes were common in one cohort of ED patients prescribed IV opioids, particularly those patients already taking long-acting opioids (higher drug tolerance), those thought by their health care provider to be drug-seeking, older patients, and patients with significant pain at presentation.[19]

Fentanyl is the best known synthetic agent and is widely used in pain control. It is 50 to 100 times more potent than morphine and has the added benefit of not causing histamine release and peripheral vasodilation, as found with morphine administration. Based on this physiology, fentanyl should not impact blood pressure as much as other narcotics and, therefore, is preferential in the critically ill trauma population who may have tenuous cardiovascular status from hypovolemic shock. Its method of delivery is diverse, ranging from intravenous to transdermal routes. More recently, the intranasal route has proven to be useful, particularly in the pediatric population.[30] It is excreted in breast milk and, therefore, breastfeeding should be held for 24 hours after its use.[31] Ultra-short-acting synthetic opioids, such as sufentanyl, have been found to be no more efficacious than protocol-driven morphine administration.[32]

One method of opiate delivery worthy of particular mention is patient-controlled analgesia (PCA), although it may not be available in the ED setting. As the name suggests, patients are able to control the amount of analgesia they receive, usually in the form of pressing a button that delivers a bolus. Inadvertent overdosing can be avoided by a built-in lockout period or maximal amount of drug that is programmed into the PCA unit. For those with significant pain, boluses can occur on top of a set basal infusion rate. One meta-analysis examining 55 studies (2,023 patients receiving PCA and 1,838 patients receiving intravenous pain medication) found better pain control and patient satisfaction than conventional parenteral "as-needed" analgesia, although there was no difference in the length of hospital stay.[33]

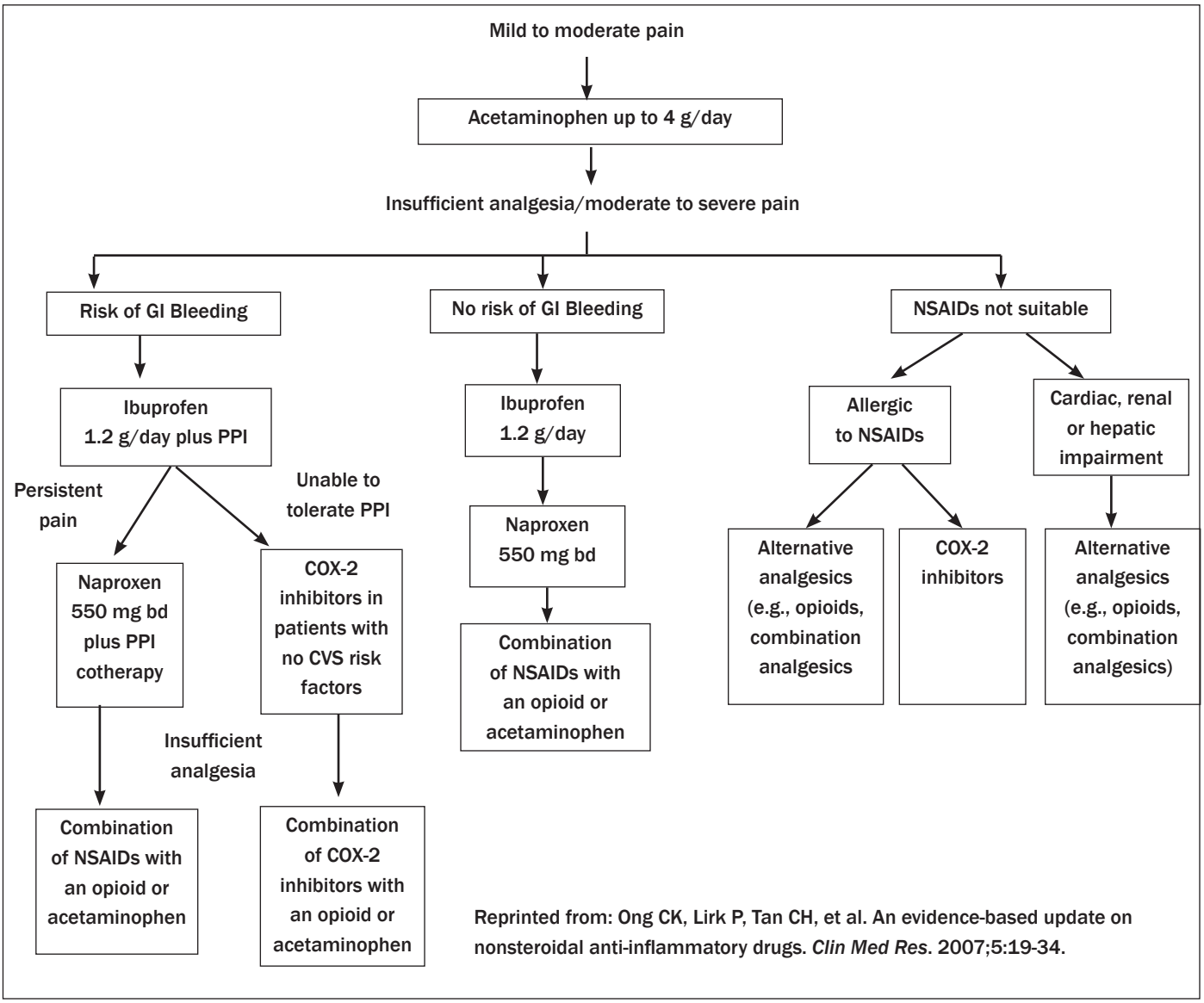
One of the most worrisome side effects of opiate use is respiratory depression, which is usually dependent on the rate and dose that is administered. More common side effects include drowsiness (75%), constipation (55%), and nausea (44%).[34] There also has been some concern in the past that opiate use may impact physical exam findings. This concept has been more thoroughly explored in the setting of acute abdominal pain. A recent meta-analysis of 8 trials (922 patients) found that administration of opioid analgesics as part of the diagnostic process for patients with acute abdominal pain prior to a diagnosis did not increase the risk of treatment errors. It did, however, significantly improve patient pain control when compared to placebo.[35,36] However, pain in the trauma setting has not been exclusively examined.

Nonsteroidal Anti-inflammatory Drugs (NSAIDs)

The NSAID class non-selectively inhibits cyclo-oxygenase (COX), an enzyme that catalyzes the formation of prostaglandins and thromboxane from arachidonic acid. Through this mechanism, NSAIDs interrupt or mitigate inflammation. The most commonly available and used NSAIDs are from the propionic acid (ibuprofen, naproxen) and acetic acid (indomethacin, ketorolac, diclofenac) derivative classes. Ketorolac is the only available NSAID in intravenous form. Selective COX-2 inhibitors (celecoxib) have been found to have adverse cardiac events and have no role in the acute management of pain. A topical NSAID form is a relatively new method of delivery that does not have the systemic side effects and has been found to have good analgesia.[37] There are no data on how large an area can be covered, and the injury needs to be relatively superficial. In general, for mild to moderate pain, NSAIDs have been found to be better pain-control agents than acetaminophen alone, but have a higher risk of adverse effects such as gastrointestinal bleeding.[38] Additionally, there are more concerning drug-to-drug interactions, with the most important one being that co-administration with aspirin decreases aspirin's anti-platelet effect.[39]

In the pediatric population, ibuprofen at 10 mg/kg was found to be equivalent[40] or superior to

Figure 2. Mild to Moderate Pain Management



Reprinted from: Ong CK, Lirk P, Tan CH, et al. An evidence-based update on nonsteroidal anti-inflammatory drugs. *Clin Med Res*. 2007;5:19-34.

codeine and acetaminophen in minor musculoskeletal injuries[41] and in the outpatient management of extremity fracture was equivalent to acetaminophen/codeine.[42]

There has been some hesitation in the past to use NSAIDs, which were thought to impede healing and growth through inhibition of the COX-2 mechanism, and increase bleeding. Neither the selective COX-2 inhibitor celecoxib nor naproxen affected secondary hemostasis in healthy male volunteers.[43] But bench research has shown retardation of bone growth in animal models, particularly in the early phase of healing, although these findings do not correlate with the limited clinical studies addressing nonunion and delayed fracture healing.[44] Because there are insufficient data examining bone healing and NSAIDs, other analgesic agents are preferred.[45] Soft-tissue healing has a similar paucity of data, but because bone formation is not involved, short courses of NSAIDs may be of therapeutic value in protecting the microcirculation and preserving skeletal muscle from secondary inflammatory tissue damage following closed soft-tissue injury and may play a role in the postoperative management following ligament reconstructions and repairs by reducing pain and swelling and allowing an earlier return of motion.[44]

Other risks occur with NSAID use, with some particularly germane to the trauma population. Perhaps the most well-known risk factor of NSAID use is gastrointestinal hemorrhage, and the trauma population is at high risk for this complication, particularly among those who:

- are greater than 65 years in age (risk increases by five times);
- are taking oral steroids (risk increases by five times);
- have a history of peptic ulcer

disease or upper GI bleeding (risk increases by five times); or

• are taking anticoagulants (risk increases by 10–15 times).[46]

These high-risk patients should receive anther pain medication or at least receive gastro-protective agents, such as sucralfate, H_2 receptor blockers, or a proton pump inhibitor. Recent evidence has suggested NSAID use, particularly ketorolac use, increases the incidence of hemorrhagic and ischemic stroke. Oral agents increase the odds of a stroke from 1.2 to 1.9 (depending on the agent used), but the odds ratio increased to the 4-to-6 range with intravenous ketorolac.[47]

Other Drugs

Other medications have been evaluated for use in the acute pain setting, with mixed results. Although gabapentin has significant value in chronic neuropathic pain, its use in the acute pain setting is not supported.[48,49] Rather, the combination of gabapentin and nortriptyline was found to be more efficacious than either drug given alone for neuropathic pain.[50,51] While carbamazepine appears to be effective in chronic neuropathic pain, there has been no meaningful comparison with other interventions, and its use in the acute pain setting has no evidence-based role.[48,52] Selective serotonin reuptake inhibitors (fluoxetine, paroxetine, citalopram) also have limited and inconsistent results, but have a superior tolerability profile compared with tricyclic antidepressants.[53]

Adjuncts: Spinal and Epidural Blocks

Epidural blocks have proven useful in thoracic and abdominal surgery as well as in cesarian sections and childbirth. This adjunct has been advocated for use in trauma, specifically for chest trauma and multiple rib fractures, an injury that is complex and has significant morbidity and mortality.[54] In 2005, epidural pain control was endorsed as a Level I recommendation for the treatment of blunt thoracic trauma by the Eastern Association of the Surgery of Trauma, specifically citing that, "Use of epidural analgesia (EA) for pain control after severe blunt injury and non-traumatic surgical thoracic pain significantly improves subjective pain perception and critical pulmonary function tests compared with intravenous narcotics. EA is associated with less respiratory depression, somnolence, and gastrointestinal symptoms."[55]

Since then, epidural anesthesia has become a modality to be considered only after patient-controlled analgesia and NSAID use have failed.[56] This is because more recent meta-analyses of previous studies specifically looking at multiple rib fractures cast a less certain light on the use of epidural pain control, finding no reduction in mortality or ICU and inpatient length of stay when compared to other pain-control modalities.[57] The placement and removal of epidurals is further limited by DVT prophylaxis, such as low molecular weight heparin, which can increase the risk of epidural hemorrhage. However, in older patients (> 65 years) with multiple rib fractures in whom high-dose narcotics or NSAIDs are contraindicated or who have serious risks (renal insufficiency, heart failure, tenuous cardiovascular reserve), an epidural catheter may be a good initial approach. The elderly, in particular, benefit from spinal opioids,[58] although they are at higher risk for complications.[59]

Epidural catheter delivery of opioids and topical anesthetics has been of great benefit in post-operative patients, particularly in orthopedic procedures that, physiologically speaking, are similar to the trauma mechanism.[60] Although the usual epidural infusion combinations are an opioid and a local anesthetic (i.e., bupivacaine), epinephrine is used as well.[61]

Adjuncts: Localized Injections and Nerve Blocks

In cases of multiple rib fractures in which contraindications to epidural catheters exist (vertebral fractures, profound hypotension), intercostal nerve blocks can be useful. Various systems have been brought to market in which a percutaneous catheter can be placed in the soft tissue adjacent to the vertebral column, through which a continuous infusion of local anesthetic can be administered to provide a thoracic paravertebral block.[62,63] The degree of pain control from this block is comparable to spinal epidurals with fewer side effects and complications.[63,64]

A host of other regional blocks are well known and used in elective, non-traumatic surgeries. They have a better safety profile than epidurals,[65] but are limited by the availability of physicians with this expertise. Ongoing studies looking at femoral blocks in post-operative and hip-fracture patients, based on prior work suggesting femoral blocks in hip fracture lead to faster pain relief and decreased opiate use, are currently underway and hold promise.[66] A recent literature review examining this issue found that studies evaluating regional blocks are hindered by small sample size and a wide variety of measurements and outcomes. Therefore, it is difficult to determine if nerve blocks confer any significant clinical benefit when compared with other analgesic methods as part of the treatment of a hip fracture. Despite these limitations, nerve blocks appear to reduce the degree of pain experienced by the patient from the hip fracture and subsequent surgery.[67]

Although joint and tendon-sheath injections with steroids or analgesics are not part of mainstream emergency medicine practice, they can be useful in traumatic pain management. Depending on the site, patient history, and level of provider comfort at performing these procedures, local injections can provide pain relief without resorting to systemic medications or may, at least, decrease the need for systemic medications. There are many small case series and prospective trials, but larger studies that allow for a definitive answer regarding effectiveness are lacking. One systematic review specifically

looking at non-traumatic tendinitis found that corticosteroid injections did provide short-term pain control. Generalized conclusions were limited because of the variation in effect between body sites.[68,69] Although traditional teaching has associated steroid injections with an increased risk of tendon rupture, there are few data to support this claim.[70,71]

Adjuncts: Ice and Heat

Despite decades of use, topical application of ice has minimal support for its use in traumatic injury.[72,73] From a physiological standpoint, vasoconstriction should decrease swelling and distention as well as release of pain mediators, but this has yet to be proven in a rigorous, prospective study. One small study evaluating ankle sprains found that applying ice for 10 minutes, then allowing re-warming, followed by another 10 minutes of ice had better ankle pain control with activity after one week when compared to the standard 20 minutes of ice every 2 hours in the acute injury phase.[74] Heat and cold application for minor musculoskeletal strains appears to be equivalent when used in conjunction with NSAIDs,[75] although heat has some potential to improve low back pain.[76]

Education

Nearly half of all ED patients in pain do not desire analgesics, despite having an average pain score in the moderate-to-severe range. Therefore, asking patients whether they have pain and whether they want analgesics should be the first step in determining the need for analgesia.[6] Educating nursing staff, physicians, and housestaff on this issue alone would greatly improve pain control.[2]

Often education of ED staff and patients can decrease oligoanalgesia through simple education,[77] namely remembering to consider pain control as part of the treatment plan. Prior work has demonstrated that nursing staff were more likely to assess pain and to respond to education centering on pain assessment, while physicians were less concerned about problems with analgesics than nurses.[78] In a busy ED or trauma center setting, the necessary reassessment can be difficult, but the institution of a standard protocol for physicians and nurses to follow (including pain medication regimens with milligram per kilogram dosing as well as frequent reassessment) improved patient pain ratings and satisfaction.[77] Treatment protocols administered by nurses have also been shown to be effective in improving the level of analgesia.[79]

Approaches to Pain Control in the Trauma Population

Early and aggressive pain control is the ideal approach for moderate to severe trauma, but other issues that pertain to the underlying traumatic injury must be considered.

Is the Patient Stable? Although pain control should be one priority in the management of trauma patients, it may not be the most important initial priority. An isolated injury, such as an open femur fracture or a dislocated shoulder, may prompt the trauma team to treat pain early, but the primary and secondary ATLS surveys should be the priority and should be completed in a short period of time to identify most causes of hypovolemic shock and hemodynamic instability that would otherwise lead to an adverse outcome.

Is There a Potential That the Patient Might Need to Go to the Operating Room or Require Procedural Sedation? Once the patient has been deemed "stable," the route of pain control should be the next consideration. For moderate to severe pain, there is a high likelihood that these patients will need intravenous access and pain control, so the intravenous route should be established early and utilized. The route of delivery becomes more complex in those patients with isolated injuries that, in most cases, could be treated with oral pain control. One such example is a deformed, swollen ankle, which may be a severe strain, a fracture, or a dislocation. Since there is a high likelihood of operative interventions or procedural sedation (such as to reduce a severely distracted fracture), intravenous pain control while the patient undergoes imaging may be a more prudent route than oral pain medication, as the oral route may delay further intervention. (Although the risk of aspiration from 50 mL of water and two pills is low, many anesthesiologists will not intervene on patients who have not been nil per os for at least 8 hours.) More recently, acetaminophen has become available in an intravenous form and could be considered for mild to moderate pain (15 mg/kg every 6 hours) or fever in those who are unable to take medications orally (such as those awaiting a procedure).

How Will Medication Impact Management of Traumatic Injuries? Ideally, longer-acting pain-control agents should be used to avoid frequent episodic pain that requires repeated dosing that occurs with shorter half-life medications. However, in the trauma population, the potential side effects of pain medicines must be considered. A common example is the patient with a subdural hematoma or intraparenchymal hemorrhage who will need serial neurological reassessments. Any decrease in mental status can result in an emergent head CT, placement of an intracranial pressure monitor, or operative intervention, so every effort should be made to minimize medications that impair mental status. Another example is a patient with an aortic injury, in whom a drop in blood pressure could potentially be from aortic hemorrhage, so medications that may cause hypotension are best avoided. In both head and aortic injuries, fentanyl would represent an ideal choice given its short half life and side effect profile discussed earlier.

With these questions in mind, a reasonable approach comes from the American Geriatric Society 2002 recommendations:

- Introduce one agent at a time,

at a low dose, followed by slow dose titration;

• Allow a sufficient interval between drugs to allow assessment of the effect;

• Monitor the patient and adjust if required to limit adverse events.

Although these recommendations are for chronic pain, the stepwise approach holds true in the acute pain setting as well.[80]

For mild to moderate pain in patients with a low likelihood of surgery or procedural sedation, acetaminophen at 4 g/day is considered first line, provided there is no underlying hepatic dysfunction or ethanol abuse.[81] If heavy alcohol use is suspected or documented, acetaminophen should be limited to 2 g/day.[39] This total daily limit should be kept in mind when other acetaminophen-containing products (i.e., Percocet) are also prescribed or are already being taken.

In the young, healthy population, NSAIDs can be appropriate first-line agents for mild to moderate pain. In the geriatric population, if NSAIDs must be used, the lowest effective dose for the shortest amount of time is suggested. Ibuprofen has been shown to be the least potentially harmful agent.[38] If there is a risk for GI bleeding, either an H_2 blocker or proton pump inhibitor can be co-administered to avoid bleeding. (*See Figure 2*). Drugs to avoid in the geriatric population include propoxyphene, indomethacin, pentazocine, and ketorolac (which has a four-fold higher risk of gastrointestinal bleeding than ibuprofen).[82]

The next level of pain control (moderate to severe) is the opiate class, with morphine, fentanyl, or hydromorphone representing the typical agents. Orally administered opiates have equal efficacy to the intravenous preparations, but if surgery is a realistic possibility (i.e., an open ankle fracture), or if pain control is needed sooner rather than later, the intravenous route should be chosen over the oral route. Caveats for the cautious use of opiates include the presence or possibility of hypovolemic shock/hypotension and respiratory depression or tenuous respiratory function (i.e., rib fractures in a COPD patient). In patients with major trauma who have suspected significant injury, fentanyl (2 mcg/kg for low dose, 2-20 mcg/kg for moderate dose, 20-50 mcg/kg for high dose) is an ideal agent, given that its half life is shorter than morphine or hydromorphone (1-2 hours vs. 4-6 hours) and the lack of histamine release that can cause hypotension. It can be used in patients with mild to moderate renal and/or hepatic dysfunction.[83]

Regardless of the agent used, frequent reassessment, ideally through a protocol that can be initiated in the ED and continued in the inpatient unit, has led to improved pain control, outcomes, and decreased cost.[84] In most patients, medication usage is a stopgap measure until definitive care (i.e., epidural for multiple rib fractures, splinting of a fractured wrist) can be obtained. Although adjuncts such as epidurals and whole extremity nerve blocks rarely occur in the ED setting, obtaining personnel who can do the procedure is the rate limiting factor, and that can at least be initiated in the ED after discussion with the trauma team.

Conclusions

The moderate to severely injured trauma population represents complex patients in whom adequate analgesia must be considered against life- and limb-threatening injury and hemorrhagic shock. Once the potential for operative intervention and hemodynamic instability have been addressed, a stepwise approach of escalating pain management can be used, with frequent reassessment incorporated into the treatment plan.

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CME/CNE Questions

1. A 38-year-old male arrives at the ED after a fall from a tree stand while hunting. His chief complaint is right leg pain. Per EMS, the patient suffered a brief loss of consciousness, but was awake upon their arrival, although slightly confused. The patient has no allergies and no medical problems. Initial vitals are: heart rate = 115 beats per minute, blood pressure = 102/50 mm Hg, temperature = 98.7° F, respiratory rate = 30 breaths per minute. On your exam, there is an obvious deformity of the right thigh with intact distal perfusion and pulses. Appropriate initial pain control would be (patient weight is 70 kg):
   A. 7 mg morphine IV
   B. 2 tablets of 5 mg oxycodone/350 mg acetaminophen PO
   C. fentanyl 50 mcg IV
   D. ketorolac 60 mg IM
   E. acetaminophen 650 mg PO
2. An excellent first-line agent for mild to moderate pain in a geriatric patient with little chance of needing immediate operative intervention is:
   A. propoxyphene
   B. pentazocine
   C. ketorolac
   D. acetaminophen
   E. meperidine
3. Fentanyl is a better agent to use in the critically injured trauma patient because:
   A. Its longer half-life decreases frequent dosing.
   B. Its lack of histamine release decreases the likelihood of hypotension.
   C. It is more easily reversible with naloxone if untoward effects occur.
   D. It has less abuse potential than other opioids.
   E. It is less expensive than other narcotic agents.
4. Application of ice or cold compresses:
   A. has been clinically proven to decrease the inflammatory response.
   B. should be avoided because of the risk of cold injury.
   C. may improve mobilization and pain control in the short term.
   D. is always beneficial for long-term pain control.
   E. can cause tissue ischemia from vasoconstriction.
5. Epidural pain control is most useful in:
   A. patients with rib and vertebral fractures.
   B. patients with a high opioid tolerance.
   C. those with only a few isolated rib fractures.
   D. patients in whom systemic pain control carries a higher risk.
   E. intubated patients on positive pressure support.
6. Pain in the acutely injured is unique because:
   A. Pain in this population tends to be moderate to severe and requires frequent reassessment.
   B. Other competing factors such as hypotension must be considered.

CNE/CME Objectives

Upon completing this program, the participants will be able to:

a.) discuss conditions that should increase suspicion for traumatic injuries;
b.) describe the various modalities used to identify different traumatic conditions;
c.) cite methods of quickly stabilizing and managing patients; and
d.) identify possible complications that may occur with traumatic injuries.

C. There is a high potential for emergent surgery, making oral medications less desirable.
D. A substantial proportion of the trauma population is elderly, in whom first-line pain medications may be contraindicated.
E. All of the above.

7. The use of nonsteroidal anti-inflammatory drugs (NSAIDs) in the elderly:
   A. is the first-line agent unless they are allergic to NSAIDs.
   B. must at all times be given with a proton pump inhibitor or H2 blocker.
   C. should be used with caution with the lowest dose and shortest duration that provides pain control.
   D. is contraindicated.
   E. should be used at half the usual dose because of impaired renal and kidney function.

8. Tendon-sheath or bursa local injections:
   A. have been well validated in multiple, large, prospective trials that support their use.
   B. can have systemic side effects despite their local use.
   C. can be a useful adjunct in practitioners familiar with their use.
   D. of steroids or local anesthetics have equal onset and efficacy.
   E. should be avoided at all times.

9. Use of gabapentin alone has significant value in acute and chronic neuropathic pain.
   A. true
   B. false

10. Populations who are well known to receive inadequate analgesia include:
    A. older patients.
    B. minorities.
    C. intubated patients.
    D. non-English-speaking patients.
    E. all of the above.

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To earn credit for this activity, please follow these instructions.

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