



Aches and Pain in the Geriatric Trauma Patient

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Abstract

Purpose of Review This review examines the pain control options for geriatric trauma patients, who represent an increasing proportion of the trauma population.

Recent Findings Current pain management of geriatric trauma patients has evolved to a multimodal pain approach including non-opioid medications and regional anesthesia, due to safety concerns with respiratory depression and delirium when using primarily opioid-based pain regimens. Ideal regimens incorporate treatment of multiple pain pathways to decrease the required dosages of all pain medicine to safer thresholds, especially in the geriatric patient population. Intravenous, oral, and transdermal adjunctive medications provide effective pain control for these patients. Regional anesthesia also improves pain control and decreases narcotic use, especially in the setting of rib and femoral fractures.

Summary The growing population of elderly trauma patients requires thoughtful multimodal pain therapy regimens tailored to injury type and personalized to the patient's comorbidities to optimize outcomes and prevent complications.

Keywords Analgesics · Opioid/adverse effects/therapeutic use · Geriatrics/*methods · Pain management/*methods · Pain · Postoperative/*drug therapy · Multimodal analgesia · Pain measurement in older adults

Introduction

As healthcare and medical technology improves, adults are living longer and maintaining high activity levels as they age. The national trauma databank shows that the number of geriatric trauma patients is steadily increasing from 23% of the total trauma population in 2003 to 30% in 2016, which is the last annual report. Among a survey of practitioners of geriatric trauma care, >80% of respondents indicated that geriatric trauma is an increasing problem, use of sedative medication

contributes to delirium, delirium is a major issue for these patients, and geriatric-specific protocols are needed [1•]. As this population continues to increase in size, trauma care needs to focus on safe and optimized care for this patient population.

Older adults exhibit unique pain control issues when compared to their younger counterparts. Multiple studies demonstrate an association between delirium, postoperative complications, mortality, falls, and the use of opioid medications in elderly patients [2•, 3, 4•]. The American Geriatrics Society Beers Criteria Update Expert Panel advises that opioid medications be used only for severe acute pain due to the increased risks for complications in this age group [4•]. Elderly patients experience higher peak effect and longer duration of the action of opioids, largely due to decreased renal and hepatic clearance and changes in body composition. As we age, the altered pharmacokinetics and pharmacodynamics increase the risk of respiratory depression, constipation, delirium, pulmonary complications, and over-sedation [5•]. Due to the risks of opioid medication in the elderly, many practitioners now prescribe adjunctive, non-opioid therapies to control pain in the geriatric trauma patient.

Unfortunately, geriatric trauma patients may have underappreciated pain. Self-report of pain by various published pain scales is the cornerstone of pain assessment; however, this may be impossible in elderly patients with cognitive

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impairment [6]. Up to 21% of patients who suffer a hip fracture after a fall will also present with dementia [3, 7]. Difficulty with pain assessment can cause pain to go undetected and unmanaged in this vulnerable population. Unmanaged pain has also been shown to increase delirium in elderly adults and can lead to prolonged bedrest after trauma or surgery [8••]. These disruptions in ambulation increase the risk of thromboembolism and functional impairment in geriatric trauma patients, which in turn may result in longer hospital lengths of stay, long-term functional impairment, and other costs [8••, 9]. Pain control in the geriatric population must therefore be a careful balance between adequately treating pain and over sedation, making multimodal pain control a necessity. Trauma practitioners must be well-versed in the various opioid and non-opioid pain control options for this vulnerable and growing population.

This review focuses on pain management options and considerations when treating geriatric trauma patients. First, we will introduce the common, non-opioid pain medications, which are given on a scheduled regimen for optimal results. Perhaps the most common mistake is to write for these medications on an as-needed basis, as patients and caregivers often think the non-opioid medications will not be strong enough. Adjunct medications should be prescribed to work synergistically with the rest of the pain regimen to get better pain control. Next, we will describe safe prescribing practices for opioid medications. Given the changes over the last 5 years in state requirements for opioid prescribing, our efforts at multimodal therapy and careful opioid use have led to a significant decrease in morphine-equivalent-dosing-per day (MEDD), which is much safer for our patients and the community [10]. Lastly, older patients are at risk for polypharmacy, which can lead to medication confusion; clear counseling and medication de-escalation strategies and timelines should be discussed with all patients to ensure that pain medications are not continued in perpetuity.

Acetaminophen

Acetaminophen represents front-line therapy for the treatment of pain in the geriatric population, and the oral formulation of acetaminophen is the most utilized adjunct. When combined with opioid pain control, oral acetaminophen produces superior analgesia and an opioid-sparing effect. By decreasing overall opioid consumption, acetaminophen also decreases opioid-related adverse effects such as postoperative nausea and vomiting and sedation [11••]. Oral acetaminophen is widely considered a necessity in most hip fracture pain control protocols. Typical dosing for multimodal therapy is outlined in Table 1. Scheduled acetaminophen should be included in all geriatric trauma pain management regimens in the absence of contraindications such as hepatic impairment.

Bioavailability of acetaminophen can be increased when administered intravenously versus orally, especially in the setting of ileus. IV acetaminophen reaches higher peak plasma concentration and exhibits a swifter onset of action, making it more efficacious. Additionally, the safety and efficacy of its use in geriatric patients has been shown to be comparable to that in younger patients without dosing adjustment [8••, 12]. In a study of elderly hip fracture patients, the use of IV acetaminophen was independently associated with decreased narcotic usage, decreased patient-reported pain scores, improved outcomes, and a higher likelihood of home discharge after surgery [8••]. However, these benefits are limited in current practice by the significant increased cost of IV acetaminophen.

NSAIDs

Traditional non-steroidal anti-inflammatories (NSAIDs) have anti-inflammatory effects, as well as antipyretic and analgesic properties. This class of medications inhibits cyclooxygenases (COXs) enzymes, which are rate-determining enzymes for prostaglandins that mediate pain and inflammation. IV formulations of NSAIDs such as ketorolac have been shown to decrease opioid medication use after surgery, decrease patient reported pain, and support earlier return of bowel function and ambulation in other surgical disciplines [13, 14]. Interestingly, IV ibuprofen every 6 h is effective in minimizing opiate use even at 400 mg dosing compared to higher dosing of 800 mg in a randomized, controlled trial [15]. Other studies also support that 400 mg dosing of oral ibuprofen is just as effective as higher dosing in the management of acute pain [16••].

Despite their efficacy in decreasing pain, NSAIDs are not without risks, especially in the geriatric population [17••]. Some reports have suggested a bleeding risk for 24 h after surgery or injury with the use of intravenous NSAIDs due to platelet dysfunction; however, this finding is not universal, and many studies report no increased risk of bleeding [11••, 18•]. NSAIDs also have an adverse effect on renal function and require careful monitoring. In the geriatric trauma patient population, we recommend no more than one or two doses of ketorolac to get control of pain before switching to oral NSAIDs for the short period of acute pain.

NSAIDs provide reliable pain relief after injury, and these medications are inexpensive and convenient to continue after discharge following a traumatic injury for a short time period. As previously shown, combining Tylenol with any NSAID demonstrates much more effective pain control than either drug alone [19••].

Gabapentin/Pregabalin

Anti-epileptic drugs such as gabapentin and pregabalin are frequently used to treat chronic neuropathic pain. However,

Table 1 Multimodal pain therapy recommended dosages for trauma patients

Therapy	Young trauma patient	Geriatric trauma patient (> 65 years old or ~GFR 30)
Tylenol ^a	650 mg PO Q6H or 1000 mg PO Q8H	650 mg PO Q6H
Toradol IV ^b or Ibuprofen PO	15 mg IV Q6H (x5 days max) 400 mg PO Q6H or 600 mg PO Q8H	15 mg IV Q6H (×1–2 doses), then 400 mg PO Q6H
Gabapentin ^c	300 mg PO Q8H	100 mg PO daily or Q8H, titrate carefully by monitoring sedation
Muscle relaxant	Flexeril 5 mg PO Q8H, can increase to 10 mg Q8H	Methocarbamol 500–750 mg PO Q6H (no loading dose), < 7–14 days ^d
Lidocaine Patch 4–5%	1–2 patches TD morning, plus 1–2 patches TD evening	1 patch morning, plus 1 patch evening
Home antidepressant	Restart home medications	Restart home medications
Magnesium IV	Goal serum level > 2.5 mg/dL	Goal serum level > 2.5 mg/dL
Oxycodone ^e	5 mg PO Q4H PRN pain 4–6, 10 mg PO Q4H PRN pain 7–10 or breakthrough dose of 5 mg PO Q6H PRN	2.5 mg PO Q4H PRN pain 4–6, 5 mg PO Q4H PRN pain 7–10 (30 MEDD = 5 mg Q6H)
IV opioid	Morphine 2–4 mg Q3H PRN breakthrough pain	Dilaudid 0.2–0.4 mg Q3H PRN breakthrough pain ^f

^a Due to newer recommendations, maximum dosage ~ 3200 mg/24 h. Monitor hepatic function

^b Monitor renal function closely, especially in the setting of diuretic or ACEi/ARB. Avoid if GFR < 30. Can increase to 30 mg IV Q6H in some young patients

^c Monitor renal function closely, can increase up to 600 mg PO Q8H in some patients

^d Use with caution, avoid except in setting of uncontrolled pain or rib fractures

^e For typical opioid naïve patient

^f Avoid morphine in the setting of decreased renal function due to metabolite side effects

some studies have shown utility in using these medications in the acute setting as part of a multimodal pain regimen postoperatively, especially with certain traumatic injuries such as spinal cord injury, oral and maxillofacial trauma, and rib fractures. Perioperative use of these medications has been shown to have analgesic and opioid-sparing effects [20, 21•]. Gabapentinoids decrease neuropathic pain in the setting of spinal cord injury [22, 23]. Additionally, a single randomized study demonstrated decreased postoperative nausea and vomiting in oral and maxillofacial trauma [24]. One randomized controlled trial did not find efficacy in the use of rib fractures; however, there was a difference between the groups in the number of rib fractures [25]. In our practice, even low-dose gabapentin is useful as part of the multimodal technique, but care must be taken to monitor for sedation. Gabapentinoids have been shown to cause sedation and dizziness and should be prescribed with caution in the geriatric population [11••, 20, 21•]. In general, we recommend starting with an extremely low dose and titrating to effect, unlike the young trauma patient who often benefits from a higher acute pain dose initially.

Muscle Relaxants

Skeletal muscle relaxants, such as baclofen, cyclobenzaprine (Flexeril), methocarbamol (Robaxin), and tizanidine (Zanaflex) are widely considered part of a multimodal pain regimen as they work in the central nervous system to reduce somatic motor

activity. The use of baclofen has been well-described in spinal cord injury or traumatic brain injury that causes increased muscle tone, and it also has the risk of increased spastic tone associated with withdrawal from baclofen [26].

Cyclobenzaprine has not been shown to be more effective than ibuprofen alone in the setting of minor cervical or myofascial strain in trauma patients in the emergency department [27, 28]. Although methocarbamol has not been shown to significantly change self-reported pain scores in one study [29], it has been associated with decreased length of stay in setting of rib fractures [30]. Of concern, multiple studies document skeletal muscle relaxants as an independent risk factor for falls in the geriatric trauma patient population, which should cause hesitation for any prescriber [31•, 32, 33, 34••]. In the older patient, tizanidine (Zanaflex) is an alpha 2-adrenergic agonist which has similar effectiveness as anti-spasmodic agent but with effects of less muscle weakness [35].

Thus, rib fractures in the geriatric patient population seem to be the only injury that benefits from low-dose methocarbamol (or tizanidine), as the risk of inadequate pain control or respiratory suppression from opioids is far greater than risk of falls while in the monitored environment.

Antidepressants

Older adults are at increased risk for depression, and studies have shown a close relationship between pain and depression in this vulnerable age group [36]. Due to this risk, it is

important to consider antidepressant medications as a possible addition to a multimodal pain management plan for geriatric trauma patients. Duloxetine, a selective serotonin norepinephrine reuptake inhibitor, has been shown to have both antidepressant and centrally acting analgesic effects [37]. It has been successfully integrated into many treatment protocols for osteoarthritis and other chronic pain disorders. Additionally, antidepressants have been shown to decrease immediate postoperative pain and long-term pain over 6 months postoperatively in mastectomy patients [38]. In general, practitioners should restart home depression medications and evaluate for a component of depression as a contributor to pain.

Magnesium

As an antagonist of the NMDA receptor, magnesium in IV formulation has been found to be an effective adjuvant to reduce opioid requirements [39••]. Studies have shown that IV magnesium sulfate decreases pain scores and opioid requirements in the first 24 h after surgery without serious adverse effects [39••, 40]. IV magnesium may be continuously infused or administered in boluses, and it is generally considered safe as toxicity is difficult to achieve. Even though magnesium is not often considered as part of a pain regimen, we recommend supplementing to achieve a serum concentration level of 2.5 mg/dl.

Topical Analgesics

NSAIDs such as diclofenac come in topical gel and topical patch form, which provide relief for mild to moderate somatic pain. Diclofenac epolamine topical patches have been shown to provide significant relief for patients with soft tissue injuries with good tolerability and no systemic side effects [41•]. Additionally, these patches have shown to provide significant pain relief in as little as 1 h after application, making them a reasonable choice for acute pain control [42].

Topical local anesthetics such as lidocaine are also an option for acute pain relief of soft tissue injuries and postoperative incisional pain with low risk of toxicity. Although an early study showed no benefit, more recent trials demonstrate that lidocaine patches decrease opioid requirements in rib fracture patients [43•, 44, 45]. Overall, topical pain relief is important to consider in geriatric trauma patients due to its efficacy and low side effect profile. We recommend use of 1–2 patches in a continuous manner over 24 h with change of patches before breakfast and before bedtime, which has been demonstrated safely [46••, 47]. Although prescription-strength patches may not be covered by insurance, lidocaine patches (such as Salonpas brand) are available over the counter for a significant cost reduction to the patient.

Regional Anesthesia

Regional anesthesia provides targeted pain relief without systemic side effects, and it has been shown effective in both rib fracture and hip fracture patients. Geriatric trauma patients with multiple rib fractures who received thoracic regional anesthesia demonstrated decreased delirium, increased utilization of non-opioid pain medication, and thereby reduced systemic opioid, benzodiazepine, and atypical antipsychotic medication administration [2••].

Furthermore, the use of continuous femoral nerve catheters in hip fracture patients decreased postoperative opioid use by 50% and decreased the rate of opioid-related side effects in geriatric patients with hip fractures in a retrospective study [48•]. Similar results are achieved with preoperative femoral nerve blocks in a randomized controlled trial [49] or fascia iliaca blocks in a prospective cohort study [50•]. A recent systematic review and narrative review discuss the benefits of femoral nerve catheters or blocks in hip fracture patients, although some of the studies included show bias and future research is needed [51•, 52]. In further support of the transition to regional pain control and regional anesthesia during operative intervention, the choice of anesthesia in the operating room for these patients has been shown to affect outcomes. The use of general anesthesia instead of regional anesthesia has increased risk of in-hospital mortality, acute respiratory failure, longer hospital stays, and higher readmission [53, 54].

Regional anesthesia effectively targets the injury to provide site-specific analgesia, which is safer than systemic pain control. The decreased systemic effects and adequate pain control minimize the risk of delirium and improve perioperative outcomes. We strongly support the use of regional anesthesia in geriatric trauma patients with both rib and hip fractures to reduce opioid consumption and improve outcomes. Future research should focus on local nerve blocks for other injuries.

Lidocaine (IV)

Lidocaine is an amide local anesthetic that has analgesic, anti-hyperalgesic, and anti-inflammatory properties. It interacts with sodium channels and different receptor and nociceptive transmission pathways centrally, and it also exhibits a peripheral anti-hyperalgesic effect on somatic pain. An infusion of intravenous lidocaine may have a useful effect in older patients with acute pain [55, 56]. After abdominal surgery in geriatric patients, a low 1 mg/kg/h infusion resulted in a 35% reduction in opioid requirements during the first 72 h [57]. While this reduction is impressive, studies have shown the benefits of lidocaine infusion in the reduction of pain dissipate at longer time frames after surgery or traumatic injury [58]. Even with the expectation of a short duration of efficacy, there are potential benefits to the geriatric trauma patient that warrant further study.

Dexmedetomidine (Precedex, IV)

Dexmedetomidine is a highly selective alpha 2 adrenoreceptor agonist, which can be used for sedation, anxiolysis, and analgesia without the associated respiratory suppression seen with other anxiolytics. A recent randomized trial demonstrates a decrease in delirium during the first week after ICU admission in patients 65 and older having non-cardiac surgery with the use of dexmedetomidine [59••]. Delirium is associated with increased morbidity and mortality, prolonged hospital admission, worse functional recovery, and long-term decline in cognitive function. The main advantage for the trauma ICU practitioner is the ability to use this medication in the setting of rib fractures, especially for anxious patients who require non-invasive ventilation or high flow nasal cannula for hypoxemia.

Ketamine (IV or INH)

Ketamine, a potent NMDA receptor antagonist, has demonstrated effectiveness in perioperative pain control, even in low doses. Widely used in the military, ketamine has been shown to decrease opioid requirements or decrease pain in the adult trauma patient, making an argument for use in the civilian trauma setting to decrease opioid consumption in geriatric patients [60]. Several studies have shown the efficacy of subdissociative intravenous-dose ketamine in the short-term treatment of acute pain in the geriatric population [61•, 62]. In a recent randomized controlled trial, a ketamine infusion was associated with decreased opioid use in geriatric rib fracture patients with an injury severity score > 15 [63••]. These studies are promising for the use of ketamine as an adjunct in multimodal pain regimens in geriatric patients.

Despite ketamine's efficacy in pain control, it has also been shown to result in higher rates of psychoperceptual adverse effects in the geriatric population and thus should be used with caution at this time [62]. Further studies in the geriatric trauma patient population are needed to demonstrate safety and efficacy.

Opioid Medications

Opioid pain control remains a mainstay of analgesia in trauma care. Opioids, both in oral and intravenous (IV) form, are extremely effective in the treatment of acute pain. Opioids act by binding presynaptic opioid receptors and stimulating them, resulting in analgesia and euphoria. The individual response to any given dose of opioid pain medication is highly variable and must be carefully tailored, particularly in the elderly. A practitioner may minimize dosage in the hope to avoid delirium, but pain itself may lead to delirium [64]. Most studies agree that opioids can and should be used for geriatric patients but often require initially reduced doses (~50%), careful monitoring, and frequent reassessment [5••, 64, 65].

Unfortunately, in the older patient, opioid use is also associated with falls, fall-related injuries, and fracture, which again underscores the importance of using opioids for short-term acute pain control and following planned weaning protocols with the assistance of adjunct medications [4••].

Opioid pain control can be administered in several forms. Patient-controlled analgesia (PCA) is useful in conscious patients who can understand and cooperate with the PCA pump. This technique allows self-dosing with IV opioids up to a clinician-determined limit, most commonly with morphine, hydromorphone, or fentanyl [66•]. Doses can be titrated to analgesic requirements while monitoring for respiratory depression and hemodynamic instability, and the safest method is the pump that blocks additional doses and alarms due to elevation of end-tidal CO₂. IV boluses generally do not maintain steady analgesic plasma levels, and thus patients should be monitored closely for under and over analgesia [66•]. For patients with multiple comorbidities, especially renal or hepatic dysfunction, route of drug clearance must be considered. Fentanyl is safe for use for both patients with renal or hepatic insufficiency and is the mainstay of pain medication treatment in the intensive care unit for patients who require continuous infusions. Oxycodone, hydromorphone, morphine, and tramadol may be used in renal insufficiency but may require dose reduction and close monitoring.

In practice, oral opioids are most effective for steady-state pain control and easier to titrate than IV formulations. In the hospital, we most commonly use oxycodone immediate-release and avoid formulations that combine the opioid with acetaminophen. Separating the opioid from the non-opioid component can promote staggered dosing intervals that minimize effectiveness (peaks and valleys) and may allow the patient to utilize a smaller overall dose of opiate. Avoiding combination formulations also minimizes the possibility of toxic levels of acetaminophen and hepatic injury.

Despite their efficacy in treating pain, opioids have been associated with complications such as respiratory depression, delirium, and cognitive decline in elderly patients. In older patients, the changes in the number and function of opioid receptors mean that sensitivity to opioid pain medications can be increased by 50%, making dosing more difficult and potentially leading to the increased number of opioid medication-related complications in this age group [67•].

Combination Therapy Considerations: Polypharmacy

The multimodal pain approach increases both the number of medications and the frequency of dosing, which significantly increases the complexity of the regimen, especially as the patient nears discharge. Polypharmacy, or the use of multiple medications, can also have negative consequences such as

adverse drug reactions, confusion about medications, recurrent falls, and increased dependence on caregivers [68]. Recent research has started to examine the effect of medication complexity on geriatric trauma patient outcomes. Many medications described above are included on the American Geriatric Society Beers criteria list and are independently associated with increased risk of falls [34••].

Complex medication regimens and risks of polypharmacy must be discussed with the patient prior to discharge to promote safety after a traumatic event. Patients must be able to verbalize understanding of the multimodal scheduled pain regimen as well as the plan and timeline for de-escalation. A careful balance of necessary medications must be reached, and the medications must be re-evaluated regularly to de-escalate regimens thoughtfully. One possible strategy for this could be through co-management with geriatric specialists, which has been shown to decrease the amount of potentially inappropriate medications in hip fracture patients at discharge [69]. More research needs to be done to determine the best strategies to optimize pain control without inadvertently increasing polypharmacy.

Conclusions

Pain control in geriatric trauma patients is multifaceted and complex, but there are many options to decrease the use of opioids in these vulnerable patients. The best pain control in the geriatric patient is achieved using a scheduled regimen of acetaminophen and NSAIDs, which are generally safe for short periods in the treatment of acute pain. If needed, titrate up low-dose muscle relaxant and gabapentin for perioperative or rib fracture pain, paying careful attention to sedation effect. Consider any other adjunctive medications including lidocaine patches, home antidepressants, or magnesium. This regimen has been highly successful at lowering the daily opioid requirement into a safer profile (< 30 MEDD), which is absolutely critical in the geriatric trauma patient. Most importantly, once oral medications are optimized, a gentle taper off medication is essential to prevent long-term complications.

Rib fracture patients benefit from this scheduled oral medication regimen, lidocaine patches, and a low-dose opioid regimen as needed. If there is concern for sedation or respiratory depression, then pursue regional anesthesia via thoracic epidural catheter or paravertebral block as quickly as possible. If anxiety and delirium are contributing factors, consider adding low-dose infusion of dexmedetomidine. Hip fracture patients will benefit from regional anesthesia before escalating the oral regimen, and this should be considered preoperatively. While IV lidocaine and IV ketamine are discussed here, they are not often used in practice, as more research needs to be done to determine the benefits.

In geriatric trauma, multimodal pain control should be tailored to each patient, and efforts should be made to minimize opioid use in this population whenever possible. Trauma practitioners must be well educated and comfortable with the various opioid and non-opioid pain control options for this vulnerable and growing population.

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Compliance with Ethical Standards

Conflict of Interest VPH spouse is a consultant for Medtronic, Sig Medical, Zimmer Biomet, and Atricare.

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