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REVIEW

Chronic Pain in Elderly Patients: Pathophysiology, Pharmacologic and Non-Pharmacologic Therapies, and Interventional Management

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Purpose: Chronic pain is a debilitating condition faced among the geriatric population, contributing to reduced mobility, impaired daily function, and increased dependence on healthcare services. This review explores the current landscape of chronic pain in the elderly, providing a comprehensive overview of treatment options, with the goal of exploring more effective, individualized care.

Patients and Methods: This narrative review draws on a range of studies and clinical publications accessible through the National Center for Biotechnology Information (NCBI) database. The literature reviewed includes research on the underlying mechanisms, diagnostic challenges, and treatment strategies for chronic pain in older adults. Clinical relevance and practical approaches were explored, where risks and benefits of pharmacologic, non-pharmacologic, and interventional therapies were explored.

Results: Chronic pain in the elderly is often undertreated, likely due to unaccounted comorbidities and age-related changes in drug metabolism. While acetaminophen remains the recommended first-line agent, the use of NSAIDs and opioids in this population carries significant risks and demands careful consideration. Adjuvant medications such as SNRIs and gabapentinoids offer additional options for neuropathic pain, but may require dose adjustments or close adverse effect monitoring. Non-pharmacologic interventions—such as physical therapy and cognitive behavioral therapy— often are underutilized despite a strong safety profile and evidence of benefit. In cases refractory to conservative measures, interventional procedures including epidural steroid injections, radiofrequency ablation, and spinal cord stimulation may offer meaningful relief for select patients.

Conclusion: Managing chronic pain in older adults requires a thoughtful, individualized approach that balances effectiveness with safety. As the population ages, there is a growing need for more inclusive research, better integration of non-drug therapies, and greater access to interdisciplinary care. Tailoring treatment to individual goals can help improve outcomes and preserve independence and function in this vulnerable group.

Keywords: multimodal pain management, opioids, non-pharmacologic therapy, interventional procedures, functional outcomes, geriatric care

Introduction

Chronic pain is a complex biopsychosocial pathology affecting all aspects of life including mood, activities of daily living, sleep, and cognition.[1] It is one of the most prevalent health conditions present in the elderly population today. Approximately 60% of people aged 65 and above suffer from chronic pain.[2] Additionally, the United States Census Bureau has estimated that 20% of the total population will be above the age of 65 in 2030, highlighting the importance of understanding and adequately addressing pain in this patient population.[3] Pain in the geriatric population is particularly difficult to assess and treat for various reasons. Many elderly patients assume pain is an inevitable and untreatable consequence of aging and thereby refrain from seeking appropriate treatment.[4] Furthermore, elderly patients with cognitive impairments are often unable to precisely locate and describe the nature of their pain, making it difficult for the practitioner to perform a comprehensive assessment. These patients are also coping with co-morbid conditions which

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can complicate treatment options. Geriatric patients are often consuming multiple medications while having underlying pharmacokinetic changes in drug metabolism, ultimately making pharmacologic responsiveness unpredictable.[5] Despite the prevalence of pain in this patient cohort, research attempting to uncover pain physiology and mechanisms in this population is limited.[6] The goal of this review is to highlight the epidemiology, pathophysiology, assessment, and management of chronic pain in the geriatric population, thereby offering practitioners clear guidance and direction in treating this unique patient cohort.

Beyond its high prevalence, chronic pain in older adults is also pathophysiologically distinct from that in younger populations. Aging is associated with structural and functional changes in both the peripheral and central nervous systems, including changes in peripheral nociceptor sensitization, impaired descending inhibitory pathways, neuroinflammation, and reduced neurotransmitter levels. These changes will predispose older adults to central sensitization, leading to a transition from an acute to a chronic pain state. This transition is further accelerated in the context of frailty, multimorbidity, and diminished physiologic reserve. A comprehensive understanding of these age-specific mechanisms is essential for developing targeted management strategies. The following sections examine these processes in detail to better understand current pharmacologic, non-pharmacologic, and interventional approaches.

Pain Prevalence

Aging and debility have been shown to increase the potential for developing chronic pain.[7] The most common pain sites include the lower back, knees, and hips.[7] Additionally, elderly women are at higher risk of developing chronic pain when compared to men.[8] Numerous studies have attempted to accurately determine the prevalence of various geriatric chronic pain conditions. One study noted the following prevalence statistics: lumbar spondylosis (65%), other musculoskeletal pain including myofascial and soft tissue disorders (40%), peripheral neuropathic pain (35%), and joint pain (15–25%).[9] Prevalence estimates vary considerably depending on the population studied and imaging modality used. For example, a systematic review by Brinjikji et al, of CT and MRI studies revealed disc degeneration in over 90% of adults aged 70 and older, although many of these findings are asymptomatic.[10] Of note, elderly patients living in skilled nursing facilities or other institutions (other than home) were found to have significantly higher rates of chronic pain, with estimates up to 80%.[11] With life expectancy continuing to increase, the number of elderly patients suffering from chronic pain will rise.

Common etiologies of chronic pain in the geriatric population include osteoarthritis, spondylosis, myofascial pain, diabetic neuropathy, and post-herpetic neuralgia. Other causes include cancer mediated pain, post-stroke pain, fibromyalgia, peripheral vascular disease, and chronic post-surgical pain.[12] The following is a brief synopsis of common chronic pain conditions in older adults.

Chronic Pain Conditions

Osteoarthritis

Osteoarthritis (OA) is an inflammatory, degenerative "wear and tear" pathology leading to the progressive deterioration of joints and cartilage.[13] The prevalence of osteoarthritis in the US ranges between 35–50% in patients aged 65 and above and is the third most common non-emergent reason patients will see their physician.[14] The pathogenesis of OA is complex and multifactorial in nature but is thought to include proinflammatory elements, biomechanical factors, and proteases.[13] Patients with OA often endorse debilitating pain exacerbated by activity and impaired joint mobility. Patients with OA may also suffer from peripheral sensitization, further exacerbating their chronic pain.[14,15]

OA mediated pain has typically been classified as nociceptive in nature. A noxious stimulus, such as tissue inflammation, causes depolarization of peripheral nerves and subsequent transmission of pain signals to the dorsal horn of the spinal cord.[13,14] However, recent studies have demonstrated a neuropathic component to OA mediated pain, which may explain why some patients do not respond to first line pharmacologic agents such as NSAIDs.[14,16,17]

OA has a clear association with aging as both prevalence and incidence of OA increases with age.[18] Nevertheless, the pathophysiology of OA and age-related structural changes are distinct processes, where aging changes make patients more susceptible to developing OA. Age related changes in the geriatric population can be classified as extracellular or

cellular. Extracellular changes include articular cartilage thinning, reduction of extracellular fluid, and increased numbers of proteins containing advanced glycation end-products (AGEs). These unique proteins lead to crosslinking of collagen and thereby biomechanical changes.[19] Type II collagen, a common protein in cartilage, has a half-life estimated to be about 100 years, leading to a low turnover rate and consequently gradual accumulation of AGEs.[20] Chondrocalcinosis, or abnormal cartilage calcification, is another extracellular change associated with age. Calcium pyrophosphate dihydrate crystals accumulate in the extracellular matrix, altering the biomechanics of the joint tissue and inducing inflammation.[21] Cellular changes correlating age and OA include increased levels of oxidative stress, mitochondrial DNA damage, impaired sensitivity to anabolic growth hormones, and reduced autophagy. Autophagy is a cellular process where cells remove damaged or dysfunctional parts and recycle them, promoting cellular repair and regeneration. These changes lead to overexpression of proinflammatory mediators and inability to repair damaged matrix, ultimately promoting joint destruction.

Spondylosis and Myofascial Pain

Spondylosis (ie., spinal degenerative changes in the discs, facet joints, vertebral bodies) and myofascial pain are common causes of back pain in the geriatric patient population, with a prevalence of approximately 30%.[22] Spondylosis is a common etiology of back pain in the elderly, and its incidence increases with age. Nearly all patients 80 years of age and above will have radiographic evidence of spondylosis, although not all will endorse symptoms.[23] Spondylosis can lead to spinal stenosis (presenting as radiculopathy or neurogenic claudication), spondylolysis, and ultimately spondylolisthesis. Myofascial pain is another common source of back pain in the elderly. Myofascial trigger points, or hypersensitive taut bands of muscle, can produce local or referred pain. Trigger points arise when there is abnormal stress on muscle fibers including from chronic microtrauma and abnormal posture, both of which are common in patients of advanced age.[24]

Neuropathic Pain

The older adult population is at an increased risk of developing neuropathic pain. Many of the pathologies linked to neuropathy increase in incidence with age, including diabetes (diabetic neuropathy), herpes zoster (postherpetic neuralgia), cerebral vascular accidents, malignancy, and limb amputations (phantom limb pain).[25] Other etiologies include vitamin deficiencies (B12 and B9), alcohol use disorder, and HIV.[26] Studies have estimated the prevalence of neuropathic pain in the elderly to be near 30%, highlighting the significance of preventing and treating this disease state.[27,28] Nevertheless, elderly patients are often disproportionally understudied in clinical trials assessing the efficacy of pharmacologic agents for neuropathic pain, questioning the broad applicability of common guidelines to the geriatric population.[28]

Diabetic Neuropathy

Diabetic neuropathy is one common cause of neuropathic pain in the elderly. Approximately one-third of the United States population over 65 years old has diabetes.[22] Amongst adults older than 65 diagnosed with diabetes, 60% endorse experiencing neuropathic pain.[22] Additionally, studies have noted a correlation between duration of diabetes and diabetic neuropathy. For example, 20% of patients who have had diabetes for less than 5 years endorse neuropathic pain, and this number jumps to 35% in patients with diabetes for more than 10 years.[29]

Post-Herpetic Neuralgia

Post-herpetic neuralgia is another etiology of neuropathic pain in older adults. It develops in patients after the varicella zoster virus, dormant in the dorsal root ganglion, is reactivated. Patients will often endorse allodynia and a burning sensation in a dermatomal distribution. Elderly patients are more susceptible to shingles due to decreased cell mediated immunity. It is estimated that 10% of patients with shingles develop post-herpetic neuralgia, and this number increases to 30% in patients older than 80. Additionally, the severity of symptoms also increases with age.[30,31] Studies have noted that some elderly patients with post-herpetic neuralgia experience pain levels similar to those who recently underwent surgery.[31]

Pathophysiology of Chronic Pain

Although chronic pain is viewed as an inevitable consequence of aging, it is typically a result of a prolonged pathological process and not necessarily from aging itself.[6,7,22] Physiologic abnormalities in the elderly affect pain transmission and processing, and these changes can be divided into peripheral and central causes.

Peripheral

Studies have found that rates of action potential firing in C fibers are higher in the elderly compared to younger patients. This can be indicative of heightened sensitivity and ultimately lead to chronic inflammation.[32] Furthermore, recovery from peripheral nerve injury is longer in elderly patients.[32,33] Others have noted a reduction of substance P, a neuropeptide inflammatory mediator, in the elderly, which theoretically would lead to a decrease in pain symptoms.[32] Overall, the evidence supporting the role of peripheral nervous system changes and their contribution to geriatric pain is limited.

Central

There are both functional and structural changes in the central nervous system that are associated with age and pain processing. Structural changes, specifically neuronal death and gliosis, in the middle insular cortex and primary somatosensory cortex of elderly patients can cause increased sensitivity to pain.[34–36] Additionally, as patients age, neurodegeneration in the prefrontal cortex and amygdala may impair the ability to cognitively and emotionally process pain.[36] Elderly patients may also experience increased activation of astrocytes and microglia in the brain and spinal cord, leading to release of inflammatory cytokines.[36,37] Changes in neurotransmitters and receptors associated with pain have also been studied. Elderly patients have been shown to have decreased levels of serotonin, dopamine, and norepinephrine, leading to impaired endogenous pain inhibition.[38–40] NMDA receptor upregulation has also been noted, causing prolonged pain despite resolution of the original injury.[37] Together, the aforementioned physiologic changes in the older adult population can contribute to central sensitization and chronic pain.

Pain perception thresholds in older adults present a complex and sometimes paradoxical picture. Some studies suggest that thermal and pressure pain thresholds are increased with age, possibly due to peripheral nerve fiber loss and reduced receptor density. On the contrary, other evidence demonstrates increased sensitivity to mechanically evoked pain, as well as prolonged pain duration following noxious stimuli, likely reflecting impaired descending inhibitory modulation and central sensitization.[5,36] This combination of reduced detection of mild stimuli, while also experiencing heightened vulnerability to persistent pain, highlights the importance of individualized assessment in this population.

Comorbidities

There are numerous comorbidities associated with chronic pain in the elderly. The risk for chronic pain and cardiovascular disease both increase with age. Patients with chronic pain have been found to be at increased risk of myocardial infarction and heart failure.[41] Diabetes Mellitus is another prevalent disease in patients with chronic pain.[41–43] Of note, obesity is common amongst patients with these conditions, highlighting the importance of managing this modifiable risk factor. Patients who manage their obesity by exercising on a weekly basis, eating healthier foods, obtaining healthy amounts of sleep, and living active lifestyles find much improvement in their chronic pain and better control of the comorbid diseases.[42,43] Practitioners who can provide or suggest integrative approaches to address these pathologies, while focusing on chronic pain, can assist with simultaneous management of multiple conditions.

COPD has also been found to be a comorbid condition in patients with chronic pain. Both involve abnormal inflammation, suggesting a potential pharmacologic target. Patients with chronic pain and COPD report higher pain levels than those with chronic pain alone.[44] Depression is another condition found in elderly patients with chronic pain, with 10–15% of the geriatric population suffering from both.[43,45] The pathophysiology of these diseases likely involves abnormalities within the monoaminergic system, specifically with the neurotransmitters serotonin, dopamine, and norepinephrine.[38–40] Some studies have demonstrated significant changes in the limbic midbrain region in patients

with chronic pain, leading to impairment of the dopaminergic system and worsening depression.[43,46] Other comorbidities in this patient population include stroke, substance use disorder, and sleep disorders.[43]

Assessment of Chronic Pain in Elderly Patients

Pain is a subjective experience that varies widely between individuals. It is influenced by a range of factors including genetics, sex, age, cognition, emotional state, and cultural background. In older adult patients, chronic pain assessment can be particularly complex due to age-related physiological changes, comorbidities, and potential cognitive decline. Understanding the origin and nature of pain is essential to guide diagnosis, management, and treatment planning.

Pain Assessment Tools

Questionnaires are the most widely used for pain assessments. Pain assessment in clinical settings often begins with self-reported questionnaires. The Numeric Rating Scale (NRS) is one of the most commonly used tools, where patients rate their pain from 0 (no pain) to 10 (worst imaginable pain). While simple and widely understood, it remains subjective and may be less reliable in patients with cognitive impairment. Other widely used assessment tools include the Brief Pain Inventory (BPI) that examines pain severity and its impact on daily functions. For neuropathic pain specifically, we can use the PainDETECT Questionnaire. Other typical questionnaires for painful conditions can be found in Table 1.

Imaging

Imaging modalities such as X-ray, MRI, and CT scans can provide valuable anatomical and structural information to complement clinical assessments, especially in elderly patients with chronic pain. However, their use should be judicious

Table 1 Common Pain Assessment Tools Used in Elderly Patients[1–5,47]

Tool	Type	Purpose/Key Features	Target Population
NRS	Self-Report	Rates pain intensity on a scale from 0–10; Simple, widely understood	Cognitively intact; mild-moderate dementia
VDS	Self-Report	Categorical descriptors (None, mild, moderate, severe). Simpler than numeric scales	Mild-moderate dementia; communication barriers
BPI	Self-Report	Assesses pain severity and interference with daily activities	Cognitively intact patients
PainDETECT	Self-Report	Identifies neuropathic pain components	Cognitively intact patients
LANSS	Self-Report + Exam	Differentiates neuropathic from nociceptive pain	Cognitively intact patients
DN4	Self-Report + Exam	Screens for neuropathic pain; 4 questions with sensory testing	Cognitively intact patients
WOMAC Index	Self-Report	Measures pain, stiffness, and function in osteoarthritis	Cognitively intact patients
FIQ	Self-Report	Assesses fibromyalgia impact on functioning and well-being	Cognitively intact patients
PAINAD	Observational	Evaluates breathing, vocalization, facial expression, body language, consolability (0–10 scale)	Advanced dementia; Non-verbal patients
Doloplus-2	Observational	Assesses somatic, psychomotor, and psychosocial behavior domains (30-point scale)	Moderate-advanced dementia; Non-verbal patients

Notes: Self-report measures should be attempted first, even in patients with mild-to-moderate cognitive impairment. Observational tools (PAINAD, Doloplus-2) are recommended when self-report is unreliable.

Abbreviations: NRS, Numeric Rating Scale; VDS, Verbal Descriptor Scale; BPI, Brief Pain Inventory; LANSS, Leeds Assessment of Neuropathic Symptoms and Signs; DN4, Douleur Neuropathique 4 Questions; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; FIQ, Fibromyalgia Impact Questionnaire; PAINAD, Pain Assessment in Advanced Dementia.

and guided by clinical suspicion rather than routine practice, given the high prevalence of age-related degenerative changes that may not be symptomatic.

X-rays are often the first-line imaging tool for evaluating chronic joint pain or suspected osteoarthritis. They are useful for identifying bone spurs, joint space narrowing, and fractures, particularly in elderly with osteoporosis in weight-bearing joints like the knees, hips, and spine.

Magnetic Resonance Imaging (MRI) offers superior soft tissue resolution and is valuable in assessing intervertebral discs, spinal cord compression, nerve root impingement, or soft tissue abnormalities. It is particularly useful in cases of suspected radiculopathy.

Computed Tomography (CT) is helpful for evaluating complex bone structures, such as the spine or pelvis, and may be used when MRI is contraindicated due to a medical condition (eg., due to pacemakers).

Despite their utility, imaging findings in older adults often reveal incidental or asymptomatic degenerative changes, such as disc bulges or osteophytes, which do not necessarily correlate with pain severity. Therefore, imaging should be interpreted in the context of the clinical presentation and not used in isolation. Over-reliance on imaging can lead to misdiagnosis, overtreatment, or unnecessary interventions.

Pain Thresholds and Quantitative Sensory Testing

These offer more target testing including pain and sensory thresholds and quantitative sensory testing including temporal summation and conditioned pain modulation, not common in clinical practice.

Sensory and Pain Threshold Testing: Using stimuli like pressure, heat, or cold to determine thresholds.

Temporal Summation: Evaluates peripheral sensitization by measuring increased pain response to repetitive stimuli.

Conditioned Pain Modulation (CPM): Tests the "pain inhibits pain" mechanism, reflecting the function of endogenous pain inhibitory pathways.

While these methods offer valuable insights, they are less commonly used in routine clinical practice due to their complexity and need for specialized equipment.

Challenges in Determining Pain Assessment

Accurate pain assessment in older adults is often complicated by factors such as cognitive impairment, dementia, communication difficulties, and the tendency to underreport pain. Patients with cognitive deficits, such as those with Alzheimer's disease or other forms of dementia, may struggle to articulate their pain experience. However, the approach to assessment should be tailored to the degree of cognitive impairment. In patients with mild to moderate dementia, self-report tools such as the Numeric Rating Scale (NRS) or simple verbal descriptors, such as "no pain", "mild", "moderate", "severe", often remain appropriate and should be attempted first if the patient has capacity.[48] When self-report becomes unreliable, such as in advanced dementia, than observational tools can be utilized. The Pain Assessment in Advanced Dementia (PAINAD) scale is widely used due to its ease of administration, and evaluates five behavioral indicators: breathing, vocalization, facial expression, body language, and consolability.[48] The Doloplus-2 is another validated observational tool that is used to assess somatic, psychomotor, and psychosocial domains, offering a more comprehensive behavioral evaluation.[48] A multimodal approach combining attempts at self-report, behavioral observation, caregiver input, and clinical context is recommended for accurate pain assessment across variations in cognition.

Other age-related issues, such as hearing loss, vision impairment, or a history of stroke (leading to aphasia or executive dysfunction), can further hinder communication and influence pain evaluations. A history of multiple comorbidities, often the case in elderly patients, can also obscure pain's origin and lead to either over- or under-treatment.

Given these complexities, a comprehensive, multimodal approach is recommended. This includes combining

- Self-report measures when possible
- Observational and behavioral tools
- Input from caregivers or family members
- Functional and physical assessments

This integrative approach helps clinicians obtain a more accurate, nuanced understanding of the patient's pain experience and ensures that management strategies are both appropriate and effective.

Pharmacological Approaches

A careful balance between relieving symptoms and minimizing side effects must be achieved when managing chronic pain in the elderly. As discussed previously, aging is associated with paradoxical changes in pain perception, involving elevated thresholds for detecting mild stimuli, but increased sensitivity to intense pain. These alterations, combined with age-related changes in drug metabolism, polypharmacy and other common comorbidities, require a strategic balance between relieving symptoms and minimizing adverse effects. Primary analgesics include acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and opioids, however each medication leads to a unique set of risks that must be considered in this population.

Acetaminophen

According to the American Geriatrics Society, the first-line analgesic for mild to moderate chronic pain, especially for lower back pain, is Acetaminophen. This is due to its favorable safety profile compared to NSAIDs and opioids.[47,49] The maximum dose of Acetaminophen is 4 gm per day, however it is important to consider those with preexisting liver disease, low body weight, or chronic alcohol use.[50] Reductions of 30–50% of this dose are advised for any elderly patient with hepatic impairment to avoid hepatotoxicity.[47] Although this analgesic works very well for nociceptive pain, it is not as helpful for pain caused primarily by inflammation or neuropathic pain syndromes. A meta-analysis of randomized trials was reviewed, and showcased Acetaminophen's increased effectiveness vs a placebo for pain, however NSAIDs were more effective for both pain relief and improving short-term function in patients with osteoarthritis.[49] Other analyses suggest that acetaminophen offers limited to moderate relief in knee and hip OA.[51] The American College of Rheumatology recommends acetaminophen as a means of multimodal pain control for OA. Note that both the NICE guidelines and American College of Rheumatology recommend topical NSAIDS for knee OA prior to oral NSAIDs.[52,53] Patient education regarding correct dose is crucial to avoid accidental overdose leading to hepatotoxicity.[47]

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)

Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used to treat inflammatory and musculoskeletal pain; however, caution must be advised in the elderly due to the increased risk of adverse effects.[47,54] This medication inhibits cyclooxygenase (COX) enzymes and thus reduces prostaglandin synthesis. These enzymes are involved in protecting the gastrointestinal (GI) mucosa, renal function, and cardiovascular homeostasis.[47] Traditional NSAIDs will block both COX-1 and COX-2 enzymes. COX-1 inhibition is linked to GI toxicity, leading to stomach ulcers and bleeding, while COX-2 inhibition has been associated with increased cardiovascular risk.[47]

Selective COX-2 inhibitors were introduced to reduce GI toxicity, however there is still controversy about their overall safety in the elderly. For example, a COX-2 inhibitor known as rofecoxib, was withdrawn from the market due to associated cardiovascular risks. The geriatric population also has an increased likelihood of concurrent treatment with aspirin or other anticoagulants, making these patients more prone to GI compromise, in addition to worsening hypertension, acute kidney injury, and congestive heart failure with NSAID therapy.[47,54] NSAIDs should always be used very carefully in this population, especially for those with increased comorbidities.

Guideline recommendations provide clearer direction on NSAID use in older adults. The AGS Beers Criteria lists non-aspirin NSAIDs as potentially inappropriate medications in older adults, particularly those with heart failure, chronic kidney disease, or history of gastrointestinal bleeding.[47,54] NSAIDs should be avoided altogether in patients with the following: renal insufficiency, active upper gastrointestinal bleeding, platelet dysfunction, cardiac insufficiency, hyponatremia, hypovolemia, hepatic impairment, or those receiving full anticoagulation.[47,54]

When NSAIDs are deemed clinically necessary despite the mentioned risks, several strategies can mitigate harm. They should be prescribed at the lowest effective dose and shortest duration, ideally less than eight days, and use of multiple systemic NSAIDs simultaneously should be avoided.[47] COX-2 selective agents, such as Celecoxib, are preferred over non-selective NSAIDs due to reduced GI toxicity. Although gastroprotection with a proton pump inhibitor remains

indicated for patients at elevated risk, prolonged PPI use can also lead to adverse side effects.[47,54] The American College of Rheumatology recommends topical NSAIDs as a safer alternative for knee osteoarthritis prior to considering oral agents.[52,53] Blood pressure and renal function should be monitored during therapy. Overall, the decision to administer NSAIDs is very individualized, and all factors of a patient's comorbidities and current medications should be considered.

Opioids

Opioids are typically used for moderate to severe pain refractory to non-opioid treatments, or when contraindications to other medications exist.[47] They can be reasonable medications to trial when functional impairment and impaired quality of life result from pain.[50] In the geriatric patient population, altered pharmacokinetics, such as reduced renal and/or hepatic clearance, or increased sensitivity to central nervous system effects, must be considered when dosing opioids. Opioid treatment should always be started at a low dose, and slowly titrated to minimize adverse effects.

The most recent CDC guideline encourages physicians and healthcare providers to prescribe the lowest effective dose of immediate-release opioids when initiating opioid therapy, and to tailor the therapy based on the expected duration of pain.[50,54] Tramadol, codeine, and hydrocodone are all weaker opioids commonly used for nociceptive and sometimes neuropathic pain. Tramadol has a dual function. It is first converted in the body to a compound that activates μ-opioid receptors, and it also inhibits serotonin and norepinephrine reuptake to enhance analgesic effects. Due to the increase in serotonin levels, the risk of serotonin syndrome exists with this medication, especially if a patient is using a selective serotonin reuptake inhibitors or monoamine oxidase inhibitors. Genetic differences in CYP2D6 metabolism also may influence the effectiveness of tramadol or codeine, as well as how likely an individual is to experience adverse effects. For patients over 75 years old who are healthier overall, the max dosage is generally 300 mg of Tramadol per day, whereas patients with hepatic/renal impairment are recommended to not exceed 200 mg per day.[47]

Morphine, oxycodone, hydromorphone, and fentanyl are all considered stronger opioids, and similar to the weaker opioids, require prescriber vigilance that typically incorporates opioid agreements, urine drug testing, and careful risk/benefit assessment. The need and duration of opioid therapy should be based on clinical judgment and individualized, patient centered decision making.[54] Patients with renal dysfunction are prone to toxic buildup of morphine-6-glucuronide, potentially leading to neurotoxic effects. Oxycodone is considered to be safer in renally compromised patients because it is hepatically cleared. This medication can also be combined with naloxone to assist with opioid-induced constipation.[47] Fentanyl is preferred in renal dysfunction due to hepatic metabolism, no active metabolites, and a lower constipation risk due to its frequent transdermal use.[47,54] This opioid should be used with caution in opioid-naive patients, as the transdermal patch form has a slower onset.

Buprenorphine

Buprenorphine is a partial mu-opioid agonist that offers many advantages in older adults. Its ceiling effect on respiratory depression provides a favorable safety profile compared to full agonists. Buprenorphine also utilizes primarily hepatic metabolism with inactive metabolites, suitable for patients with renal impairment.[47,54] Transdermal buprenorphine has demonstrated efficacy in chronic musculoskeletal and neuropathic pain in the elderly, providing lower rates of constipation compared to other opioids. Additionally, buprenorphine's unique pharmacology may reduce the risk of opioid-induced hyperalgesia, beneficial for long-term management.[47] In the postoperative setting, short-term opioid use may be appropriate for older adults when non-opioid alternatives are inadequate, however, clinicians should anticipate an increased sensitivity to opioid effects, start therapy at low doses, and implement early transition to non-opioid analgesics when feasible.[54]

All opioids should be monitored for benefits outweighing any harms, respiratory depression, cognitive impairment, sedation, constipation and increased fall risk, especially in the elderly population. Compared to younger adults, the older population has a much lower prevalence of opioid abuse; however, regular assessment of opioid misuse, abuse, or addiction should be performed in these patients based on risk mitigation strategies.[47] For example, national data on past year opioid misuse indicate a lower rate in older adults (2.3% rate in 60 years and over) versus younger adults (3.2% in 18–25 years).[55] This lower misuse risk, combined with the high prevalence of chronic pain in this population, suggests opioids may be a reasonable consideration for strategically selected elderly patients when other treatment options have

failed. In all cases, regular assessment for misuse, abuse or addiction should still be performed using validated screening tools and risk mitigation strategies, including opioid agreements and urine drug testing.[47,54]

Antidepressants and Antiepileptics

Antidepressants exert analgesic effects as well, especially beneficial in managing neuropathic pain. They work primarily by inhibiting reuptake of serotonin and norepinephrine along descending spinal pain pathways, which modulate pain signaling and thus how the brain perceives pain.[47] Certain antidepressants also have adjunctive effects for pain relief by modulation of histamine receptors and sodium channels.[47]

Tricyclic Antidepressants (TCAs), such as amitryptiline, notriptyline and doxepin, may aid in the management of neuropathic pain. Use of these medications in the elderly is typically avoided, as their anticholinergic side effects can lead to a various unfavorable side effects, such as urinary retention, constipation, dry mouth, as well as increased risk of confusion or altered memory.[47,54]

Serotonin-norepinephrine reuptake inhibitors (SNRIs), such as venlafaxine and duloxetine, also are beneficial in neuropathic pain management, and are more favorable in the elderly due to fewer side effects compared to TCAs.[47] One study has shown that Venlafaxine has analgesic effects at doses of 225mg daily, with more than half of patients experiencing at least a 50% pain reduction compared to placebo. On the other hand, a common adverse effect of Venlafaxine is hypertension, which will be problematic for the older population. Duloxetine is deemed a more appropriate SNRI for the elderly, as it lacks cardiovascular side effects and has demonstrated a 50% reduction in diabetic peripheral neuropathic pain compared to placebo.[47,54]

Antiepileptic drugs (AEDs), although originally developed with the goal of treating seizures, can also be used to manage neuropathic pain by stabilizing overstimulated neural membranes. Carbamazepine is an AED that functions by blocking voltage-gated sodium channels, and is a first-line medication for trigeminal neuralgia. Its use in older adults however is often limited due to complex drug interactions and potential side effects.[54] Oxcarbazepine and lamotrigine may also be considered for neuropathic pain management if carbamazepine is not tolerable.

Gabapentin and pregabalin, are two of the most commonly used agents in this class. They work by binding to the alpha-2-delta subunit of voltage-gated calcium channels in the central nervous system, reducing the release of pain-signaling neurotransmitters. Gabapentin and pregabalin are FDA-approved and used in treating postherpetic neuralgia and off-label for diabetic neuropathy, where pregabalin is also approved for fibromyalgia management as well. Both of these agents have been shown in older adults to improve mood, pain, and sleep as well.[47] On the other hand, both of these medications were listed in the 2015 American Geriatrics Society Beers Criteria as potentially inappropriate due to side effects of dizziness, somnolence, and increased fall risk in the elderly.[54] Emerging evidence also raises concern for cognitive effects. A large retrospective cohort study found that perioperative gabapentin use in adults over the age of 65 was associated with increased risk of delirium, with greater risk observed in patients with preexisting chronic kidney disease.[56] While causality has not been definitively established, these findings underscore the need for cautious use in cognitively impaired older adults. Careful consideration of these medications should be performed in patients at fall risk, as well as those with renal compromise as these medications are renally excreted.

Pain Medications to Avoid or Use with Caution in Elderly Patients with Comorbidities

Choosing appropriate analgesics in the elderly requires extensive consideration of age-related changes, common drug interactions, and accounting for various comorbidities. Certain medications should either be dosed cautiously or just avoided altogether in this patient population to avoid any further decline.

Acetaminophen is typically considered one of the safer first-line analgesics for mild to moderate pain in the elderly, particularly for musculoskeletal or osteoarthritic conditions.[47,49] Caution should still be exercised in patients with underlying liver disease, patients who have alcohol use disorder, or any other hepatotoxic conditions. Hepatic toxicity can occur with doses exceeding 4g per day, or in cases of chronic overuse. Dose reductions of 30–50% have been recommended in studies for patients with hepatic compromise.[47] It is also important to be aware of unintentional

overdose from simultaneous use of analgesics that contain acetaminophen as well, portraying the importance of patient education prior to starting this analgesic.[47,54]

NSAIDs have a well-known risk of GI bleeding and ulceration in seniors, especially when simultaneously taking this medication with anticoagulants, SSRIs, baby aspirin, or corticosteroids. Due to renal vasoconstriction effects, these agents are known to cause hypertension, and exacerbate acute kidney injury in patients who are on Renin Angiotensin Aldosterone System (RAAS) inhibitors, or existing chronic kidney disease (CKD). It can also exacerbate congestive heart failure as well, and should be used cautiously in patients with cardiovascular compromise.[47,54]

Opioids can have significant effects on respiratory depression, sedation, cognition, constipation, and can increase fall risk in the elderly.[47] In addition to these, weaker opioids such as tramadol also risk serotonin syndrome when combined with SSRIs, whereas codeine and dihydrocodeine can have unpredictable effects due to differences in individual's CYP2D6 genes.[47,54] Morphine is avoided in those with renal dysfunction, as it can build up and cause neurotoxicity. For renally impaired patients, safer options include hydromorphone, oxycodone, or fentanyl, as these are hepatically cleared.[47] It is also important to avoid fentanyl transdermal patches in opioid naive patients, as the slow absorption can pose significant risks in the elderly.[47,54]

TCAs are avoided altogether in older adults due to its anticholinergic properties, risking worsening urinary retention, fall risk, cognitive impairment, and QT prolongation.[47,54] Low dose gabapentin and pregabalin, very commonly used in neuropathic pain, are renally cleared and must be used with caution in the elderly as well. Dosages should be heavily considered in the elderly to make sure the benefits outweigh the risks.[47,54]

Overall, the therapeutic benefits of analgesics must always be weighed against the risk of adverse effects, and each individual should be assessed thoroughly prior to beginning these medications. Frequent follow ups, renal and hepatic monitoring, and patient education regarding adverse effects should be prioritized. When feasible, the attempt to utilize non-pharmacological management, interventional treatment modalities and avoidance of opioids should always be considered first to minimize adverse effects.

Non-Pharmacological Approaches to Chronic Pain Management in Older Adults

Non-pharmacological treatment modalities should always be considered when appropriate to avoid the harmful adverse effects of certain analgesics. These options are very beneficial in the elderly as they not only assist with physical symptoms, but emotional and social aspects of pain as well, aligning with the biopsychosocial model of care.[57,58]

Physical Therapy and Exercise

Physical therapy (PT) is often recommended as first-line for chronic pain in the elderly, especially in individuals with reduced mobility. Daily physical exercise, including aerobic exercise, stretching, strength training, can improve functional mobility, ease pain, and enhance one's quality of life. In a 2023 systematic review regarding nonpharmacological interventions for chronic pain, strong evidence for the benefits of exercise in minimizing disability and improving physical endurance and strength in the geriatric population.[58] Additionally, participating in physical therapy allowed patients to become more independent, and improve pain to lessen the frequency of analgesic use.[58]

Cognitive Behavioral Therapy (CBT)

Cognitive behavioral therapy (CBT) is a well-established psychological treatment for chronic pain, and has shown particular effectiveness in the elderly when used with multidisciplinary care models. This type of therapy improved mental health by allowing patients to overcome their avoidance of activity, and allow improved coping mechanisms. In a 2018 meta-analysis regarding 22 randomized trials, a conclusion was made that CBT significantly minimized pain intensity, disability, and negative thought processes in older adults who were demotivated.[58] Another study in 2020 in Japan had found that an independently managed program utilizing BT had showed improvements in self-efficacy, confidence, emotional well-being, and overall function in three months.[58]

Complimentary Therapies

Additional non-pharmacological therapies include modalities such as massage, acupuncture, and transcutaneous electrical nerve stimulation (TENS). TENS in particular has been has been shown to improve pain levels in the elderly who suffer from chronic lower back pain, as well as knee osteoarthritis. While the benefit varies between individuals, this therapy is generally well-tolerated and can be useful as adjunct therapy when medications are limited in this population.[58] A summary of pharmacologic and non-pharmacologic management options, including indications and geriatric-specific considerations, is provided in Table 2.

Interventional Pain Procedures

Epidural Steroid Injections

Epidural Steroid Injections (ESIs) are a common and effective interventional treatment modality for chronic back pain, specifically lumbosacral or cervical radicular pain which radiates down the extremities. The combination of local anesthetic and corticosteroids are used to deliver medication into the epidural space. This procedure is done most commonly via a transforaminal, caudal, or interlaminar approach. In the elderly population, ESIs can be particularly beneficial as for patients who are not surgical candidates, especially due to comorbidities or advanced age barriers.[59]

Clinical evidence has shown that this procedure is beneficial for radiculopathies, especially when due to a disc herniation, compared to solely axial back pain without nerve involvement. Meta-analyses and prospective studies have shown substantial relief from both transforaminal and interlaminar ESIs. The length of pain relief varies in individuals, however there are some cases that have shown prolonged pain control, delaying or even eliminating the need for surgical intervention.[59]

Utilizing the transforaminal approach allows increased precision of medication delivery to the affected spinal nerve root and dorsal root ganglion. This approach may provide quicker symptom relief compared to interlaminar routes, with certain studies portraying improved outcomes within the first two weeks alone.[59] These studies however also show that by 6 months, both techniques seem to offer similarities in long-term symptom management. A significant finding was

Table 2 Pharmacologic and Non-Pharmacologic Management Options for Chronic Pain in Elderly Patients[47,49,54,58]

Modality	Examples	Recommended for	Key Considerations in Elderly
First-line Analgesic	Acetaminophen	Mild-moderate nociceptive pain	Max 4g/day; reduce 30–50% in hepatic impairment; limited for inflammatory pain
NSAIDs	Topical diclofenac, oral ibuprofen	OA (topical preferred), inflammatory pain	Lowest dose, shortest duration; avoid in CKD, CHF, GI bleeding risk
Opioids	Buprenorphine, oxycodone, fentanyl	Moderate-severe pain refractory to non-opioids	Start low, titrate slowly; buprenorphine preferred; avoid morphine in renal impairment
SNRIs	Duloxetine, Venlafaxine	Diabetic neuropathy, chronic musculoskeletal pain	Preferred over TCAs; monitor BP with venlafaxine
Gabapentinoids	Gabapentin, Pregabalin	Postherpetic neuralgia, neuropathic pain	Renal dose adjustment required fall and cognitive risk
Physical Therapy	Strengthening, aerobic exercise, stretching	Chronic MSK pain, reduced mobility	Strong evidence; improves function and independence
CBT	Individual or group therapy	Chronic pain with psychological component	Improves coping, reduces catastrophizing; underutilized
TENS	Transcutaneous electrical stimulation	Chronic low back pain, knee OA	Well-tolerated; adjunctive role

Abbreviations: OA, osteoarthritis; CKD, chronic kidney disease; CHF, congestive heart failure; GI, gastrointestinal; MSK, musculoskeletal; SNRIs, serotonin-norepinephrine reuptake inhibitors; TCAs, tricyclic antidepressants; BP, blood pressure; CBT, cognitive behavioral therapy; TENS, transcutaneous electrical nerve stimulation.

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also that the analgesic effect of ESIs does not seem to be specific to the dose, where lower doses of corticosteroids may be just as effective. This is an important consideration in the attempt to minimize systemic corticosteroid use in the elderly.[59]

For treatment of axial back pain, ESIs are not as effective, as there is no specific spinal nerve involvement in these conditions. The evidence does not strongly support ESIs use in generalized back pain or spinal stenosis without radiculopathy symptoms present, as relief is only short-lived.[59]

Cervical radicular pain has been shown to benefit more from interlaminar epidural steroid injections compared with the transforaminal approach. Research has shown patients can experience improved pain levels for months following treatment. Interlaminar ESIs are commonly used for spinal stenosis, cervical disc herniations, and pain after any cervical surgery.[59]

In summary, ESIs are an minimally invasive treatment modality for elderly patients with radiculopathy, especially for confirmed disc herniations or spinal stenosis. Precise anatomical targeting are important to optimize therapeutic outcomes and limit potential complications.[59]

Radiofrequency Ablation

Radiofrequency ablation (RFA) is a minimally invasive procedure used to treat chronic axial back pain, most commonly arising from facet joint arthropathy. Other RFA uses include sacroiliac joint pain, knee osteoarthritis by targeting the genicular nerve, and other peripheral neuropathic conditions. This intervention works by disrupting pain signals from being transmitted to the brain by thermally coagulating sensory nerves. This low-risk procedure is especially beneficial to elderly patients who are not surgical candidates, those with poor tolerance to pharmacological analgesics, or those who need to be weaned off of opioids.[60]

Prior to performing an RFA, a diagnostic medial branch nerve block is performed to ensure the appropriate nerve is being targeted. Once this diagnostic block with only local anesthetic is successful, a specialized electrode is placed under image guidance, most commonly fluoroscopy, and high-frequency alternating currents are then utilized to generate heat, and thus a thermal lesion around the desired nerve. This mechanism is thought to disrupt afferent pain signals transmitted from the dysfunctional joint or soft tissue to the central nervous system. This intervention typically provides relief anywhere from 6–12 months, however this varies in individuals based on the rate of nerve regeneration, as well as other comorbidities.[60]

RFAs are commonly used for lumbar and cervical facet-mediated axial pain. Numerous studies have shown that in those patients who undergo a successful diagnostic block, an RFA has portrayed statistically and clinically significant improvements in pain reduction and increased function compared to placebo or conservative management.[60] In a randomized controlled trial, evidence showed that lumbar medial branch RFAs had significantly positive outcomes in lower back pain management at 6 months following treatment compared to other controls.[60] Similar results were seen for cervical medial branch RFAs, however various anatomical considerations and more precise techniques are required due to the vertebral artery and spinal cord being in close proximity.[60]

The advantages of RFA in the elderly are due to the ability for this intervention to administer long-term pain relief and reduction in disability without the adverse effects associated with opioids or corticosteroids. In addition to this, there is no general anesthesia required, making it favorable for patients with extensive comorbidities. Some of the rare complications that have been reported with RFA are transient paresthesia, localized discomfort, or neuritis. Studies have shown however that there are no significant long-term nerve damage changes, making this intervention favorable for repeat injections of pain relief.[60]

Other areas where RFA has proven beneficial include sacroiliac joint, genicular nerve for knee osteoarthritis, and greater occipital neuralgia. All of these conditions are common in the elderly population. In summary, RFA shows promise as a safe and low-risk intervention that provides long-term reduction of pain in the elderly who suffer from spine or joint-related conditions. This allows for reduction of harmful side effects associated with opioids or corticosteroids, improving overall function.[60]

Sacroiliac Joint Injections

Sacroiliac (SI) joint dysfunction is another significant contributor to chronic axial low back pain in the elderly. This is especially common in patients who suffer from degenerative changes, such as histories of lumbar fusions, pelvic trauma, or leg length discrepancies. SI joint pain is a clinical diagnosis, which can be confirmed using a diagnostic block utilizing local anesthetic under image-guidance. The gold standard for imaging utilized during this procedure are fluoroscopy or CT guidance, as these provide efficient and accurate means for delivery of the injection due to the variable anatomy in individuals.[61]

Diagnostic injections are deemed successful when patients demonstrate at least 50% pain relief following the injection. Once this is achieved, corticosteroid injections can be offered for longer term analgesia, which typically lasts for a few months.[61] This procedure is another low-risk option for elderly patients, as it can significantly decrease the frequency of pharmacologic medications, such as NSAIDs or opioids. Complications are minimal due to the precision using fluoroscopy or CT, however some that have been reported include injection-site soreness and minor bleeding at site.[61]

SI joint dysfunction is common in the geriatric population, as these individuals are prone to bone degeneration, more sedentary lifestyles, and various lumbar/hip dysfunctions that may be predominant. This procedure offers a minimally invasive, low-risk alternative to diminish symptoms.[61]

Peripheral Nerve Blocks

Another interventional option includes peripheral nerve blocks, used to target specific sensory nerves with local anesthetics, and when indicated with corticosteroids. These injections have proven beneficial in a variety of sensory nerves such as suprascapular, genicular, ilioinguinal, and occipital nerves.[62] Targeting these sensory nerves alleviate pain in the shoulders, knees, pelvis, groin, and help manage headaches. Similar to the prior interventions discussed, peripheral nerve blocks can have positive outcomes in patients suffering more focal neuropathy.

This intervention is used with image-guidance from fluoroscopy or ultrasound to increase accuracy for these anatomically variable regions. Peripheral nerve blocks allow for more precision to minimize localized pain, being able to target more specific joints. Studies have shown that these injections have helped the elderly with their daily function, reducing frequency of falls, and reducing progression of immobility-related dysfunctions.[62] They have also been shown to reduce opioid dependence and increase engagement and progress during physical therapy sessions.[62]

The risk of this procedure is low, with complications including bleeding, infection, nerve damage or irritation, however these are minimal due to the procedure being performed in a sterile fashion, along with utilizing image guidance for precision. Repeated injections can be performed, however if pain is refractory to peripheral nerve blocks, then a radiofrequency ablation may be considered depending on the case.[62]

Trigger Point Injections

Trigger point injections (TPIs) are specifically used to target myofascial pain syndromes. Myofascial pain is common in the elderly due to worsening posture, immobility, and age-related degenerative changes. They are clinically diagnosed in patients who have nodules in the skeletal muscle, which lead to referred pain and tight bands of muscle in the surrounding area. These develop most commonly in muscles such as the trapezius and levator scapulae due to poor posture, as well as paraspinal and gluteal muscles. These muscles are sources of common complaints in the geriatric population, making TPIs an excellent option for shorter-term relief. The benefits of short-term relief include increased patient progression through physical therapy and allow for advanced quality of life.[63]

TPIs carry very low complication rates when performed in a sterile fashion, where complications include injection site soreness, minor bleeding, or ecchymosis. Depending on where the injection is being delivered, there is always risk for pneumothorax, however this is exceedingly rare.[63]

Spinal Cord Stimulators

Spinal cord stimulation (SCS) is a neuromodulatory therapy which is utilized in more chronic, refractory, and intractable neuropathic dysfunction. Patients may be offered this modality when conservative measures, pharmacologic, and interventional procedures have been ineffective. This procedure involves electrodes being placed in the epidural space, delivering low-voltage electrical currents to the dorsal columns, and thus disrupting afferent pain signaling to the brain. This procedure is most commonly offered to patients who have failed back surgeries, complex regional pain syndrome (CRPS), refractory diabetic or peripheral neuropathy, where the pain is often debilitating and significantly affects daily function.[64]

The procedure starts with an initial diagnostic trial, where electrodes are placed in the epidural space under fluoroscopic guidance. The goal is to achieve more than 50% pain reduction during this trial. If this is achieved, the SCS can be permanently implanted for pain relief. The electrodes function via different waveforms, such as tonic, burst, and high-frequency stimulation, each offering different patterns of paresthetic effects. SCS provides long-term pain relief, improved mobility, where effects do not diminish with age.[64]

Compared to other interventions discussed, SCS does come with higher risk complications. Some of these include, infection, device-related discomfort after implantation, and electrode lead migration within the epidural space. An individual's anatomical variations have large influences on the functionality of SCS due to electrode placement.[64]

Intra-Articular Injections

Intra-articular injections are heavily utilized in managing chronic joint pain, especially with osteoarthritis of the knee, hip, or shoulder in the elderly population. The most frequently used intra-articular injections involve hyaluronic acid (HA), corticosteroids, as well as biologics such as platelet-rich plasma (PRP).[65] The most common of these injections will involve corticosteroids, as the advantages include significant anti-inflammatory properties, rapid onset of function, and evidence-based efficacy in reducing synovitis and pain in osteoarthritis. In the elderly, it has been shown that corticosteroid injections have shown relief most commonly of 4–6 weeks, reducing symptoms from OA flares.[65]

HA is a natural component of synovial fluid, and is used in viscosupplementation therapy to help restore lubricating and shock absorbing properties of OA-affected joints. The overall effectiveness of HA is debated, some studies showing relief that lasts several months in many patients.[65]

Intra-articular injections are typically performed using anatomical landmarks of larger joints, or can be performed under ultrasound or fluoroscopy. The procedures are generally safe, however risks include post-injection flare, bleeding, and rarely joint infections. Anticoagulation status of older patients must be considered prior to administration.[65]

When these injections are integrated into a broader treatment plan, including physical therapy and pharmacologic support, they can be used synergistically to provide positive outcomes on symptom relief, as well as delay or avoid surgical requirements.[65]

Corticosteroid-based interventional procedures can offer significant benefits in the elderly, including rapid symptom relief, reduced need for systemic analgesics, and improved functional capacity. On the contrary, clinicians should be well aware of potential systemic effects with repeated injections. Transient hyperglycemia is well-documented, peaking within 24–48 hours, and resolving within several days. Diabetic patients should be counseled to monitor blood glucose more frequently after these interventions.[47] Repeated corticosteroid exposure has also been associated with reduced bone mineral density, a cause of increased concern in postmenopausal women and older men at risk for osteoporosis. Local effects of corticosteroid interventions which should be monitored include skin hypopigmentation and atrophy. To minimize these risks, clinicians should use the lowest effective corticosteroid dose and limit repeat injections based on symptom recurrence, rather than a routine schedule. A summary of interventional procedures, their indications, and considerations in elderly patients is provided in Table 3.

Discussion

Pain management in older adults who have multiple comorbidities, age-related physiological changes, and are marginalized in clinical trials can be challenging. The goal of this review is to outline up-to-date strategies for pain management

Table 3 Interventional Procedures for Chronic Pain in Elderly Patients[58–64,66]

Procedure	Indication	Approach/ Technique	Expected Duration of Relief	Key Considerations in Elderly
Epidural Steroid Injections	Lumbosacral/cervical radiculopathy	Transforaminal, interlaminar, caudal	Weeks to months	Most effective for disc herniation; lower steroid doses may be equally effective
Radiofrequency Ablation	Facet arthropathy, knee OA, SI joint pain	Medial branch, lateral branch, or genicular nerve	6-12 months relief	Requires diagnostic block; avoids systemic medications risks
SI Joint Injection	Sacroiliac joint dysfunction	Fluoroscopy or CT-guided	Weeks to months	Common in lumbar fusion history or leg length discrepancy
Peripheral Nerve Block	Focal neuropathic pain (shoulder, knee, groin, headache)	Ultrasound or fluoroscopy-guided	Variable	Reduces opioid dependence; improves PT participation
Trigger Point Injection	Myofascial pain syndrome	Palpation-guided or ultrasound	Short-term	Low risk; facilitates PT progression
Intra-articular Injections	OA flares, joint pain	Landmark, ultrasound, or fluoroscopy	4–6 weeks (corticosteroid); months (HA/PRP)	Limit repeat corticosteroid use; HA and PRP may offer longer relief but evidence is mixed
Spinal Cord Stimulation	Refractory neuropathic pain (FBSS, CRPS, diabetic neuropathy)	Percutaneous trial, then permanent implant	Long-term	Requires cognitive capacity for trial; higher procedural risk

Abbreviations: SI, sacroiliac; OA, osteoarthritis; CT, computed tomography; PT, physical therapy; HA, hyaluronic acid; PRP, platelet-rich plasma; FBSS, failed back surgery syndrome; CRPS, complex regional pain syndrome.

that include pharmacologic, non-pharmacologic, and interventional therapies while emphasizing the importance of individualized treatment plans.

Interpretation of Key Findings

Among used pharmacologic agents, acetaminophen is considered a first-line option for those managing mild to moderate pain. However, its limitations are in the management of inflammatory conditions, such as osteoarthritis or chronic low back pain, where its analgesic benefit is often insufficient.[47,49.] For patients who require additional pain relief, nonsteroidal anti-inflammatory drugs (NSAIDs) may be considered, but with caution among those with multiple comorbidities such as gastrointestinal bleeding, renal impairment, and increased cardiovascular events.[47,49,54]

In patients who experience moderate to severe pain and who have been unresponsive to other therapies, opioid analgesics that include weaker agents (ie., tramadol and codeine) and stronger ones (ie., morphine, oxycodone, and fentanyl) may be appropriate. However, the use of these agents is associated with an increased risk of side effects including sedation, falls, cognitive decline, and hormonal disturbances, especially in the elderly population.[47,54] Tramadol, specifically, has its own side effects due to its serotonergic effect and CYP2D6 metabolism. It is known to increase the risk of serotonin syndrome and neurotoxicity, making it a less favorable agent in this population.[47,54]

Adjuvant medications are often used in managing neuropathic and mixed pain syndromes. These agents include SNRIs (eg., duloxetine, venlafaxine) and gabapentinoids (eg., pregabalin, gabapentin). Although these agents are generally effective, they must be prescribed with caution due to their side effects and importantly renal clearance. One major concern is the risk of falls, especially among patients who experience dizziness, hyponatremia, or polypharmacy.[47,54]

The Role of Non-Pharmacologic Approaches

The role of non-pharmacologic interventions in older adults has demonstrated benefits in alleviating their pain, enhancing physical function, and improving emotional and mental health.[57,58] These interventions include physical activity, cognitive behavioral therapy (CBT), and mindfulness-based exercises. These approaches are low-risk and advantageous for frail or medically complex patients, for whom pharmacologic options may be limited or contraindicated.[8,10,57]

Although non-pharmacologic strategies are shown to be effective, they are often underemployed in clinical practice due to physical or cognitive limitations, lack of access to services, and limited provider training. Expanding access can include telehealth-CBT, community-oriented exercise programs, and interventions for the geriatric population that can provide an opportunity to enhance quality care and patient outcomes.[57,58]

Value of Interventional Therapies

Interventional therapies can provide a more targeted approach when conservative measures prove to be ineffective. Therapies such as transforaminal epidural steroid injections (ESIs) are effective for managing lumbosacral and cervical radicular pain, and may even help delay surgical intervention in select cases.[59] Additionally, radiofrequency ablation (RFA) can provide significant pain relief for 6 to 12 months in patients experiencing facet joint pain. This is proven to be effective, especially when preceded by a diagnostic medial branch block to locate the pain source.[60]

Other therapies, such as sacroiliac joint injections, peripheral nerve blocks, and trigger point injections are well-tolerated in the geriatric population and serve as both diagnostic and therapeutic purposes.[61–63] For patients experiencing refractory neuropathic pain, spinal cord stimulation (SCS) offers a neuromodulatory treatment even in patients 70 years and older, given that the functional status and cognitive capacity of the patients are thoroughly evaluated during the selection process.[64]

Intra-articular corticosteroid injections remain vital for short-term symptom relief in osteoarthritis-related joint pain. Therapies such as hyaluronic acid and platelet-rich plasma (PRP) injections show great promise in improving pain and function, although there are cost-related challenges that limit their widespread use.[65]

Persistent Challenges in Clinical Practice

Effective pain management in older adults can be limited by clinical, systemic, and societal challenges. In those with cognitive impairment, assessment can be complicated, while age bias and communication limitations can lead to ineffective treatment.[3,6,47] Many providers may be hesitant in incorporating interventional therapies either due to lack of training or concern over comorbidities.[12,59,60]

Healthcare systems often lack in their coordinated, and multidisciplinary care models that support non-pharmacologic and interventional therapies. Additionally, many interventions remain poorly reimbursed or inaccessible to patients without caregiver support or transportation.[54,58]

Limitations

This review has several limitations that should be considered. As a narrative review, it does not employ a systematic search strategy with predefined inclusion and exclusion criteria. While peer-reviewed studies, clinical guidelines, and clinically relevant publications were prioritized, the absence of a structured methodology introduces the potential for selection bias and limits reproducibility. Additionally, the evidence for pain management in older patients remains limited, as frail, cognitively impaired, and individuals with multimorbidities are frequently underrepresented in randomized controlled trials. Consequently, much of the pharmacologic and interventional data are derived from studies with either younger or healthier populations. There was also no standardized framework, such as GRADE, applied to formally grade the strength of evidence supporting each treatment modality. The relative weight of various interventional procedures and regenerative therapies should be interpreted accordingly.

Furthermore, this review does not provide quantitative comparisons of effect size, duration of symptom relief, or cost-effectiveness across the various modalities discussed, reflecting the heterogeneity of outcome measures in this population. The evidence gathered also primarily reflects populations of North America, followed by other international sources. This can limit generalizability due to differences in healthcare infrastructure, reimbursement models, and access

to multimodal services. Finally, while this review focuses on individualized and multidisciplinary care, it does not utilize a validated clinical algorithm to incorporate frailty status, comorbidities, and risk stratification. Future research should focus on developing structured, evidence-informed care pathways tailored specifically to geriatric populations.

Gaps in Research and Future Directions

Older adults are consistently underrepresented in clinical trials, even with the growth of evidence base for pain management. Studies frequently exclude patients with cognitive impairment, functional dependence, or comorbidities. These features are common in the elderly population. There is a pressing need for age-stratified analyses, long-term safety studies, and comparisons of multimodal strategies in geriatric groups.[1,19,20]

Research on the most optimal combinations of therapies, behavioral interventions, and effectiveness of other integrative therapies such as acupuncture and tai chi are limited.[54,57] Cost-effectiveness studies and evidence-based practices will also be crucial for informing policy and clinical practice.[57,58]

Implications for Practice and Psychosocial Considerations

When older patients experience pain it deeply affects all other aspects of their life including their mood, sleep, mobility, and social participation. Clinicians should strive to adopt a holistic, functional, and individualized-centered framework of action that incorporates the patient's goals, values, and context.[1,8,10]

Routine screening for depression and anxiety are critical as these factors often worsen pain-related disability. There are geriatric-specific tools such as the Beers Criteria, fall risk assessments, and frailty indices that can guide safe practices.[3,6,7] Ultimately, the integration of multidisciplinary teams, including primary care, pain specialists, physical therapists, and psychotherapists will be essential to closing the gap between evidence and practice.[47,57]

Future Directions

As our population ages, chronic pain in older adults is becoming one of the most pressing challenges in modern medicine. While improvements in understanding how to assess and manage pain in this population have been made, there is still much research to be done. Our current tools include both diagnostic and therapeutic, and are often derived from studies that marginalize older adults or fail to consider the complexities of aging, comorbidities, and functional decline. Moving forward, we must shift toward care that is not only evidence-based, but also individualized, interdisciplinary, and inclusive of the unique needs of older patients.[1,19,57]

Age-specific research is often lacking from research. Far too often, older adults are excluded from clinical trials due to comorbidities or cognitive impairment, yet these are the population of patients we see every day in practice. Future research should focus on specifically including older patients with various degrees of frailty and cognitive function and focus on endpoints that matter to this population—not just pain scores, but efforts to make improvements in mobility, independence, mood, and caregiver burden.[2,3,20]

Integrating pharmacologic, non-pharmacologic, and interventional therapies must be the approach to the future of pain management for older adults. Non-pharmacologic therapies such as cognitive behavioral therapy (CBT) and physical therapy have consistently demonstrated to be promising, yet many patients have limited access to these services, especially for those with mobility restrictions or socioeconomic barriers.[57,58] Platforms such as digital CBT and home-based rehabilitation may help open these barriers but will require validation in this age group.[8,58]

From an interventional standpoint, procedures such as spinal cord stimulation and radiofrequency ablation show promise, but the data remain sparse in older populations. We need more age-stratified trials that evaluate safety, long-term outcomes, and quality of life following these procedures.[60,64] Similarly, the role of regenerative treatments such as platelet-rich plasma (PRP) deserves exploration in elderly cohorts with osteoarthritis and joint degeneration.[65]

Geriatric-specific pain management must be advocated for on a systems level. This includes adequate reimbursement for non-pharmacologic treatments, greater access to interdisciplinary pain programs, and enhanced training for clinicians in geriatric medicine.[3,54,57] Pain in older adults is not just a sensory experience but often associated with isolation and depression. Addressing these elements requires a holistic interdisciplinary team.[48,57]

Finally, we need better clinical tools and care algorithms that account for the nuances of aging—tools that can guide decision-making in patients with polypharmacy, renal impairment, or frailty, and help avoid the harms of over- or under-treatment.[47,54] Cost-effectiveness studies that look at real-world outcomes,such as days at home, prevention of falls, and hospitalization avoidance, are equally essential.[54,57,58]

In summary, the future of chronic pain management in older adults will depend on how well we can individualize therapy, integrate non-pharmaceutical strategies, and build care systems that reflect the lived experiences of aging. With thoughtful research and collaboration, the gaps between evidence and practice can be narrowed.

Conclusion

Effective management of chronic pain in the elderly requires a tailored and multimodal approach revolving around the various physiologic, cognitive, and social factors that surround this population. This review synthesized current evidence across central domains of geriatric pain management. Age-related changes in pain processing described previously predispose older adults to the transition from acute to chronic pains states. Assessment of pain may be complicated by cognitive impairment, communication barriers, and multimorbidity, which will thus require different evaluation strategies utilizing caregiver input, observational tools, as well as self-reporting.

From a pharmacological standpoint, acetaminophen remains first-line, NSAIDs require caution, and opioids involve a careful risk-benefit analysis. Adjuvant agents such as gabapentinoids or SNRIs can offer alternative neuropathic options with appropriate dose adjustments. Non-pharmacologic interventions, particularly consisting of physical therapy and cognitive behavioral therapy, remain underutilized despite strong evidence. When conservative measures fail, interventional therapies such as radiofrequency ablations, epidural steroid injections, and spinal cord stimulation may provide relief for appropriately selected patients, although evidence in frail and cognitively impaired populations remains limited.

It is important to understand that reduction in pain intensity alone is insufficient for the treatment of older adults. Clinicians should prioritize functional outcomes, preservation of independence, fall prevention, reduction of polypharmacy, and improvement in quality of life. This review contributes an integrative perspective bridging non-pharmacologic, pharmacologic, and interventional treatment modalities, a scope not commonly presented within a single narrative synthesis. Future research should prioritize frailty-stratified trials, long-term safety data, and inclusion of cognitively impaired older adults. Effective pain management in this population ultimately requires individualized, interdisciplinary care that prioritizes function and patient-centered goals.

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