World Neurosurgery: X 23 (2024) 100273

Contents lists available at ScienceDirect

World Neurosurgery: X

journal homepage: www.journals.elsevier.com/world-neurosurgery-x

Acute back pain: The role of medication, physical medicine and rehabilitation: WFNS spine committee recommendations

Salman Sharif [a,*], Muhammad Yassar Jazaib Ali [a], Yeşim Kirazlı [b], Ian Vlok [c], Corinna Zygourakis [d], Mehmet Zileli [e]

[a] Department of Neurosurgery, Liaquat National Hospital & Medical College, Karachi, Pakistan
[b] Department of Physical Medicine and Rehabilitation, Ege University, Izmir, Turkey
[c] Department of Neurosurgery, University of Stellenbosch and Tygerberg Academic Hospital, Cape Town, South Africa
[d] Department of Neurosurgery, Sanko University Faculty of Medicine, Gaziantep, Turkey
[e] Department of Neurosurgery, Stanford University School of Medicine, California, USA

ARTICLE INFO

Keywords:
Acute low back pain
Management
Medicines
TENS
Acupuncture
Exercise programs
WFNS consensus

ABSTRACT

Objectives: To formulate the most current, evidence-based recommendations for the role of medication, physical medicine, and rehabilitation in the management of acute low back pain lasting <4 weeks.
Methods: A systematic literature search in PubMed and Google Scholar databases was performed from 2012 to 2022 using the search terms "acute low back pain," "drugs," "bed rest," "physical medicine," rehabilitation." Standardized screening criteria resulted in a total of 39 articles that were analyzed, including 16 RCTs, 8 prospective studies, 6 retrospective studies, and 9 systematic reviews. This up-to-date information was reviewed and presented at two separate meetings of the World Federation of Neurosurgical Societies (WFNS) Spine Committee. Two rounds of the Delphi method were utilized to vote on the statements and arrive at a positive or negative consensus.
Results and conclusion: The WFNS Spine Committee finalized twelve recommendation guidelines on the role of medication, physical medicine and rehabilitation in the management of acute LBP. We advocate for a uniform approach to the treatment of these patients, including proper patient education and utilizing drugs with proven efficacy and minimal side effects. First-line pharmacologic agents are acetaminophen and NSAIDs; muscle relaxants can be used for spasms and pain reduction, and opioids should be minimized. Continued activity, rather than bed rest, is recommended, and lumbar spine orthotics may be used to reduce pain and augment functional status. Thermotherapy, cryotherapy, TENs, spinal manipulative therapy, and acupuncture may all be used as adjuncts to improve acute LBP.

1. Introduction

Lower back pain (LBP) is one of the major contributors of disability worldwide.[1,2] Approximately 90% of all patients with low back pain have non-specific LBP. Diagnosis of LBP is based on the exclusion of specific causes of LBP, such as disc herniation, infection, malignancy, and other red flags.[3] Patients with acute LBP pain are initially evaluated for red flags, which denote a more serious etiology requiring urgent evaluation.[4] If red flags are excluded, physicians may educate the patient regarding the non-specific etiology of their pain and provide reassurance about the likelihood of a favorable outcome. Patients are usually educated regarding minimal bed rest and activity modification, with return to work and normal activity as soon as possible.[5] Short-term heat application may be advised,[6] as well as local short-term application of a capsicum-based or other topical cream.[7] Acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and muscle relaxants are usually the first-line medical therapies, followed by physical therapy and various rehabilitation maneuvers.[8] Opioids are usually avoided unless pain is very severe in intensity and/or unresponsive to other medications.[8]

Despite these general recommendations, there is a relative paucity of evidence-based guidelines in the literature to dictate the treatment paradigm for acute low back pain. Most of these management options are based on individual preferences and the personal experience of the physicians dealing with LBP. There is a marked difference in treatment

* Corresponding author. Department of Neurosurgery, Liaquat National Hospital & Medical College, Karachi 74800, Pakistan.
E-mail address: sharifsalman73@gmail.com (S. Sharif).

https://doi.org/10.1016/j.wnsx.2024.100273
Received 2 August 2023; Accepted 1 February 2024
Available online 6 March 2024

Abbreviations

WFNS	World Federation of Neurosurgical Societies
RCT	Randomized controlled trial
LBP	Low back pain
NSAIDs	Non-steroidal anti-inflammatory drugs
COX	Cyclo-oxygenase Enzyme
TENS	Transcutaneous electrical nerve stimulation
WHO	World Health Organization
FDA	Food and Drug Administration
NICE	The National Institute for Health and Care Excellence
ALBP	Acute Low Back Pain
CLBP	Chronic low back pain
PACE Trial	Acetaminophen in Acute Low Back Pain
CI	Confidence Interval
ED	Emergency Department
VAS	Visual Analogue Scale
ODI	Oswestry Disability Index
QoL:	Quality of life
RMDQ	Roland–Morris Disability Questionnaire
DVT	Deep Venous Thrombosis

protocols followed by various medical professionals, particularly those of different specialties (primary care versus pain management, physical medicine, and rehab, or spine surgeons), producing a heterogeneous approach to this group of patients.

The goal of this study was to perform a systematic literature review of all relevant recent studies on the conservative initial treatment of acute lower back pain. We then used a Delphi method with two consensus meetings to generate twelve consensus statements from the World Federation of Neurosurgical Societies (WFNS) Spine Committee. These guidelines provide the latest evidence-based recommendations for the role of medication, physical medicine, and rehabilitation in the management of acute low back pain for spine surgeons practicing worldwide.

2. Methods

2.1. Literature review

We performed a literature search on PubMed and Google Scholar from 2012 to 2022 using the keywords "low back pain + acute + management + drugs", "low back pain + acute + management + bed rest", "low back pain + acute + management + physical medicine", and "low back pain + acute + management + rehabilitation". The keyword '"chronic" was excluded from the title of these studies. Our PubMed search yielded 180 articles, while the Google Scholar search resulted in 514 articles. These were carefully screened by the co-authors (as shown in Fig. 1), resulting in 39 final articles analyzed for this study. We excluded duplicate articles, those for which full text was not available, studies not in English, studies with <50 participants, and non-human studies. We focused specifically on prospective and retrospective case series, randomized control trials, systematic reviews, and meta-analyses. Our study adheres to PRISMA and Cochrane Review methodology.

The goal of our systematic review was to answer the following questions.

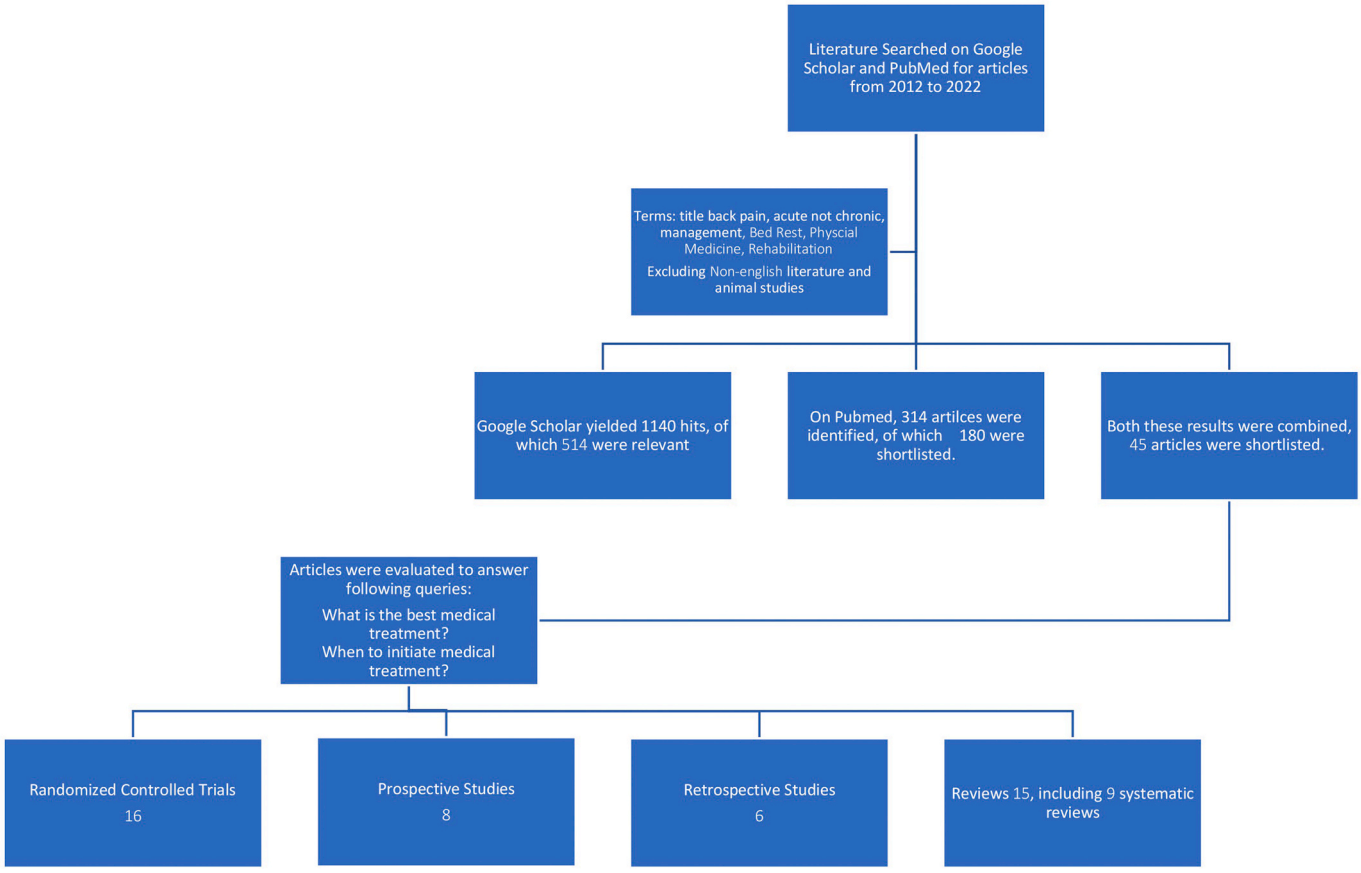

Fig. 1. Flow chart showing search methodology.

1) Which analgesic drugs are recommended for acute LBP? Specifically, what is the role for acetaminophen (acetaminophen), NSAIDs, and opioids in acute LBP?
2) Is there a role for neuropathic agents such as pregabalin (Lyrica) in acute LBP without radiculopathy?
3) What is the evidence for prescribing muscle relaxants in acute LBP? What is the effectiveness of benzondiazepine compared with non-benzodiazepine muscle relaxants?
4) Is bed rest recommended in patients with acute low back pain, and if so, for what duration?
5) What is the role of lumbar support belts, cryotherapy, thermotherapy, exercise programs, spinal manipulative therapy, and acupuncture in acute low back pain?

2.2. Consensus meetings

Drafted statements on the role of medication, physical medicine, and rehabilitation in acute low back pain were reviewed by expert panelists in the WFNS Spine Committee Consensus Meetings conducted first in May 2022 in Karachi and then in September 2022 in Istanbul. Nine members of the WFNS Spine Committee who are attending neurosurgeons with significant spinal expertise, as well as one invited physical medicine and rehab (PM&R) physician, participated in the meetings.

The Delphi method was utilized.[9] To generate a consensus, each participant voted independently and anonymously on each statement using a Likert-type scale from 1 to 5 (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = disagree, 5 = strongly disagree). Results were presented as the percentage of respondents who scored each item as 1, 2, or 3 (agreement) or 4 or 5 (disagreement). Positive or negative consensus was achieved when the sum for agreement or disagreement, respectively, was $\geq = 66\%$. The final twelve consensus statements are presented and discussed here.

3. Results and discussion

3.1. Role of pharmacologic therapy in acute back pain

Multiple drug therapies are used in clinical practice to manage acute LBP, including acetaminophen, NSAIDs (non-steroidal anti-inflammatories), opioids, neuropathic pain agents (pregabalin or gabapentin), and muscle relaxants. There is ongoing debate and lack of consensus among clinicians regarding which medications are ideal for acute onset low back pain.

3.2. Acetaminophen

Acetaminophen (Tylenol, also known as paracetamol) was approved by the United States Food and Drug Administration (FDA) in 1951. WHO recommends it as the first-line treatment for non-specific LBP.[10] According to FDA labeling, the exact mechanism of action for acetaminophen is not fully established but involves centrally inhibiting COX-1 and COX-2 pathways.[10] There is no peripheral COX activity, so no peripheral anti-inflammatory effects have been noted. Antipyretic effects of acetaminophen are attributed to the direct action of the drug on the hypothalamus.[11] Contraindications to acetaminophen use include severe hepatocellular insufficiency, hypersensitivity to the drug itself, hepatic failure, renal insufficiency, and any condition resulting in low glutathione reserves, including chronic alcoholism, excessive alcohol intake, bulimia, anorexia, and chronic malnutrition.[12]

The benefits of acetaminophen include a favorable safety profile and low cost.[13] Current NICE guidelines (2016)[14] recommend that acetaminophen should be used in conjunction with a weak opioid for managing LBP. EBM (2019)[15] and OPTIMa (2016)[16] guidelines recommend acetaminophen in acute lower back pain.[3] One study of 127 patients in Japan found that acetaminophen provided similar pain-relieving effects for acute lower back pain as the NSAID loxoprofen for at least four weeks.[17] In a double-blind randomized control trial (PACE trial) across 235 primary care centers (550 patients receiving acetaminophen versus placebo for acute LBP, followed for 3 months), however, there was no significant difference in pain control between the two groups, although non-compliance was a potential limitation of the study.[18]More specifically, acetaminophen, either taken regularly or as needed, was not more effective than placebo in reducing pain intensity (primary outcome) or secondary outcomes such as physical functioning, quality of life, and time to recovery.

A randomized, single-blind prospective study found that low-level heat wrap therapy (at 40 C for 8 h per day) was superior to acetaminophen (4000 mg per day) or ibuprofen (1200 mg per day) in treating acute lower back pain. The heat wrap significantly improved lateral trunk flexibility, as well as muscle stiffness and disability, as compared to either acetaminophen or ibuprofen.[18] In another randomized, double-blind study conducted in two urban emergency departments (120 patients with acute atraumatic non-radicular LBP randomized to ibuprofen plus placebo versus ibuprofen plus acetaminophen), there was no significant difference in pain improvement at 1 week between the groups.[19] Both of these studies argue against a significant benefit of acetaminophen use in acute LBP.

A recent meta-analysis through 2015 concluded there is no substantial evidence to suggest that acetaminophen (administered at 4 g per day) is superior to placebo at treating short-term acute back pain (from 1 week up to 12 weeks), quality of life, function, or sleep quality. [20] The most recent meta-analysis published by Shaheed et al. in 2021 analysed 36 previous systemic reviews and also concluded that, when used alone, there is no significant benefit to acetaminophen in treating acute lower back pain.[12] Table 1 provides a summary of the RCTs comparing the outcomes of acetaminophen vs. placebo.

It is important to note that pain as a symptom does, in fact, respond to acetaminophen. However, because of its central-acting nature and lack of anti-inflammatory properties, it may not be as effective at treating acute LBP. However, acetaminophen use may support other first-line interventions, including multi-modal pain regimens and physical therapy. Koes et al. provide an expert opinion that despite its lack of proven efficacy in reducing acute LBP, acetaminophen should still be considered an option for acute LBP, particularly in conjunction with non-pharmacologic therapies.[20]

3.3. NSAIDs

Non-steroidal anti-inflammatory drugs (NSAIDs) are also used in the treatment of acute LBP. NSAIDs have antipyretic, analgesic, and anti-inflammatory properties. While they are widely used for symptomatic pain control, they are not known to alter the disease course itself. Based on the half-life, NSAIDs are divided into short-acting (pain relief <6 h, including ibuprofen, diclofenac, and indomethacin) and long-acting agents (pain relief >6 h, including celecoxib and piroxicam).[22] The mechanism of action of NSAIDs is to inhibit cyclo-oxygenase, thereby impairing the transformation of arachidonic acid to prostaglandins, prostacyclin, and thromboxanes. The extent of enzyme inhibition varies among the different NSAIDs depending on which isoform of COX is inhibited (COX-1 vs. COX-2). Selective COX-2 inhibitors benefit from reduced gastroduodenal toxicity, with minimal to no effect on platelet function and reduced bleeding risk. In addition, there is little risk of precipitating bronchospasm in patients with aspirin-induced asthma and reduced incidence of significant renal events.[22] NSAIDs are used with caution in patients with renal, cardiovascular, and gastrointestinal systemic side effects, and the lowest effective dose should be used for the shortest duration possible.[13,23]

A randomized, double-blind study conducted by Plapler et al. showed that both ketorolac (an IV NSAID) and naproxen reduced pain in moderate-to-severe acute low back pain over five days, as measured by VAS scores and the Roland–Morris Disability Questionnaire. The ketorolac group had a higher percentage of participants with improved

Table 1
RCTs evaluating outcomes of acetaminophen vs placebo in acute LBP.

Authors	Year of study	Number of Patients with ALB	Interventions and their Duration		Outcomes
Nadler et al[18]	2002	371	(1) heat therapy (2) ibuprofen (1.2 g/d) (3) paracetamol (4 g/d) (4) placebo (5) unheated back wrap	2 days	Pain relief after 3–4 days: group 2 (1.68) group 3 (1.95) Disability after 3–4 days: group 2 (2.7) group 3 (2.9)
Williams et al[21]	2014	1653	(1) Acetaminophen regular (3990 mg/d) (2) Acetaminophen as needed (max 4000 mg/d) (3) placebo	4 weeks	No difference in outcome between the 3 groups. Pain intensity after 2 weeks: Group 1 (2.6) Group 2 (2.6) Group 3 (2.5) Mean disability afer 2 weeks: Group 1 (5.2) Group 2 (5.4) Group 3 (5.3)
Friedman et al[19]	2020	120	(1) Ibuprofen + Acetaminophen (2) Ibuprofen + placebo	7 days	No difference in outcome between the 2 group Pain after one week none/mild: Group 1 (72%) Group 2 (72%) Improvement disability: Group 1 (11.1) Group 2 (11.9)

pain relief 1 h after receiving the first dose (24.2%) compared to the naproxen group (6.5%; $p = 0.049$). Heartburn, nausea, and vomiting were the most common adverse effects.[24]

Roelofs and colleagues conducted a Cochrane-based systematic review in 2008, including 65 trials with 11,237 patients. Of these, twenty-eight trials were considered to be of high quality. They concluded that NSAIDs had significantly better outcomes in controlling LBP than placebo, with no significant difference between COX1 and COX2 inhibitors in efficacy. However, COX-2 selective agents had significantly fewer side effects.[25] A more recent meta-analysis published in 2016[26] (including 13 RCTs) reported that NSAIDs are more effective than placebo in reducing acute LBP intensity. NSAIDs were found to be slightly more effective than placebo at reducing LBP-related disability. No significant difference in efficacy was identified between different types of NSAIDs. Drawbacks of this study, however, include the fact that only RCTs were included, sample sizes were relatively small, and follow-up periods were short in most of the included trials.[26]

Finally, Van der Gaag and colleagues[27] published a meta-analysis in 2020, including 32 trials and 5356 participants, to evaluate the role of NSAIDs in acute LBP. They reported moderate-quality evidence that NSAIDs are slightly more effective than placebo in reducing pain intensity (as measured using the visual analog scale) in the short-term ($\leq$3 weeks). There was no significant difference in short-term pain reduction between selective COX-2 inhibitors and non-selective NSAIDs.[27] Table 2 shows the RCTs evaluating the outcomes of NSAIDS in comparison to acetaminophen in low back pain.

3.4. Opioids

Opioids are a class of natural and synthetic substances that interact with one of the three primary opioid receptor systems: mu, kappa, and delta. These drugs are commonly used to relieve pain and induce analgesia and can depress the central nervous system. In the past three decades, the utilization of opioids for chronic pain management has risen, leading to an opioid epidemic in the United States and other nations, largely attributed to over-prescription.[28] Opioid agonists activate opioid receptors in the presynaptic terminals of the nociceptive C-fibres and A-delta fibers. They indirectly inhibit voltage-dependent calcium channels, decreasing cAMP levels and blocking the release of pain neurotransmitters such as glutamate, substance P, and calcitonin gene-related peptide from nociceptive fibers.

Recent NICE guidelines (updated 2020)[29] suggest there is no evidence that the use of opioids in acute LBP leads to long-term dependence on the medication. However, a recent RCT of 174 patients receiving oxycodone-naloxone versus placebo showed no significant difference in LBP severity at 6 weeks, suggesting that opioids should not be used routinely for acute non-specific LBP.[30] There are multiple other studies[16,17,21,31,32] that fail to show a benefit for opioids in treating acute LBP.

Tramadol is an atypical oral opioid with a maximum dose of 300–400 mg/day and a half-life of 7.65 h.[29] Tramadol, and more potent opioids should be considered judiciously and only for severe, disabling LBP that cannot be controlled with other pain agents after all, other

Table 2
RCTs evaluating outcomes of acetaminophen vs NSAIDs in acute LBP.

Authors	Year of publication	Number of Patients	Interventions	Duration of Intervention	Outcome Assessment Tools	Results
Nadler et al.[18]	2002	371	(A) ibuprofen (1200 mg/d) (B) Acetaminophen (4000 mg/d)	2 days	Pain relief (NRS 0–5); Disability (RMDQ 0–24)/follow up 4 days	No difference regarding pain and disability Pain relief after 3–4 days: group A (1.68) group B (1.95) Disability after 3–4 days: group A (2.7) group B (2.9)
Miki et al.[17]	2018	127	(A) loxoprofen (60 mg-3 times/d) (B) Acetaminophen (600 mg-4 times/d)	4 weeks	Pain (NRS)/follow up 4 weeks	No significant differences Mean difference I pain score Group 1 (−0.5) Group 2 (0) High Drop-out rate of 45 percent

pharmacologic and non-pharmacologic options have been exhausted.[13] These medications should be used in a time-limited course, re-evaluating analgesic efficacy, improved activity, adverse effects, and aberrant behavior (4A's).[13] Dependence and withdrawal must be discussed with patients. Physicians should determine a medication plan with patients ahead of time, including specifically the expected course length and potential side effects. Opioids should be prescribed cautiously in patients at risk for addiction, personal or family history of addiction, poorly controlled psychological comorbidity, sexual abuse history, and young age <45 years old.[33]

3.5. Neuropathic pain agents

The precise mechanism of action of pregabalin (Lyrica), a neuropathic pain agent, remains unknown. The suggested mechanism of action is binding to the alpha2-delta protein subunit of voltage-gated calcium channels in the CNS, thus reducing excitatory neurotransmitter release. Its site of action is the cortex, olfactory bulb, hypothalamus, amygdala, hippocampus, cerebellum, and dorsal horn of the spinal cord grey matter.[34]

In their 2017 RCT published in the New England Journal of Medicine, Mathieson et al.[35] found no significant difference in leg pain, disability, or quality of life in patients randomized to Lyrica versus placebo for acute or chronic radicular pain. However, another study from the European Spine Journal (2015) showed that Lyrica was more effective than opioids in relieving neuropathic and lower extremity pain.[34] Another study (Journal of Pain Research, 2015) showed that Lyrica improved pain control for LBP with accompanying lower extremity pain, as well as pain-related sleep interference, at 4 weeks.[36] While many studies suggest there is no benefit to using Lyrica in acute LBP or chronic LBP without radicular symptoms, several medium-quality studies indicate that lyrica may be beneficial in treating neuropathic leg pain.[37]

3.6. Muscle relaxants

Muscle relaxants are the third most commonly prescribed medication for LBP. They represent a broad class of drugs, including non-benzodiazepine anti-spasmodic and benzodiazepines. They help in reducing muscle spasms after injury and also have sedative effects.[38]

Short-term studies of 2-week duration show that muscle relaxants provide superior analgesia to placebo, with no clear difference between specific muscle relaxants.[23,33] The primary associated side effects of muscle relaxant use are central nervous system sedation and risk for falls.[33] While US guidelines[39] recommend muscle relaxants as a drug of choice for LBP, Belgian guidelines[39] discourage their use for acute LBP, d UK guidelines provide no recommendation either for or against their use.[40]

A systematic review published in 2015, including 15 trials with 3362 participants, found that muscle relaxants provide clinically significant short-term pain relief for patients with acute LBP.[41] However, there was no information available on long-term outcomes. A randomized, double-blind clinical trial comparing the efficacy of diazepam + naproxen to placebo + naproxen found no significant difference between the two groups in pain control at 1 week or 3 months in patients presenting to the emergency department with acute, non-traumatic, non--radicular LBP.[42]

A more recent meta-analysis (2021)[38] covered 31 trials and 6505 participants, reporting that muscle relaxant use was associated with decreased acute LBP for less than or equal to two weeks. However, there was no significant reduction in LBP-related disability. The evidence was of low to medium quality. In the future, high-quality, large, placebo-controlled trials are needed to further investigate the role of muscle relaxants in treating acute LBP. Although the evidence is inconclusive, benzodiazepine and non-benzodiazepine muscle relaxants are still used frequently to reduce severe spasms and back pain.

3.7. Physical medicine and rehabilitation

3.7.1. Bed rest

Most guidelines[31,32,43–47] recommend avoidance of bed rest for patients with acute LBP. Consistent evidence points to continued activity leading to better symptomatic and functional outcomes in both the short and long term for acute LBP.[48] A systematic review of 10 RCTs suggests that staying physically active results in small improvements in pain relief and functional status, although the benefit is modest and the evidence is of moderate quality.[49–51]

There is additional evidence suggesting that, between the 3 to 12-week period, physical activity is more effective than bed rest in reducing pain and improving function.[52,53] Prolonged bed rest may lead to multiple adverse effects, including joint stiffness, muscle wasting, loss of bone mineral density, pressure sores, and DVTs.[52,54]

3.8. Lumbar support belts

There is limited evidence for using lumbar spine orthotics to treat low back pain. One multi-center study showed that wearing a lumbar belt can significantly improve functional status and pain levels and reduce pharmacologic consumption in subacute low back pain patients.[55] (Fig. 2) Another small study of 36 patients found that patients wearing abdominal belts had slightly decreased pain intensity and improved function at up to three weeks. The effect of elastic abdominal belts appears to be a temporary neutral alteration of trunk muscle coordination, with some trunk muscles becoming more active and others less active, rather than uniform muscle deconditioning as has been suspected in the past.[56]

Another important concern is whether lumbosacral orthoses are harmful and result in atrophy of trunk musculature. In their review

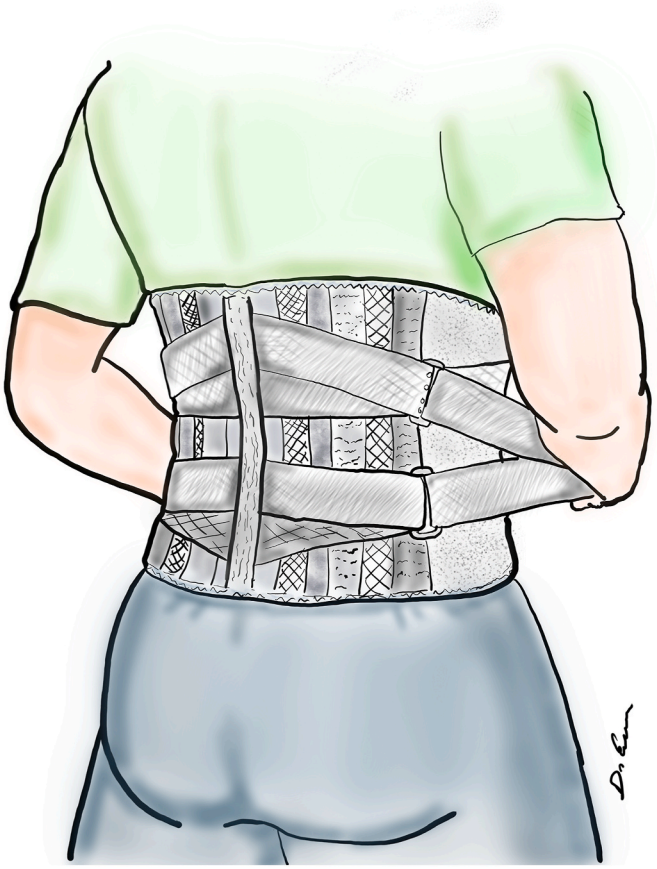

Fig. 2. Picture demonstrating a Lumbar Support Belt.

published in 2017, Azadinia and colleagues did not find conclusive evidence to suggest that orthosis results in trunk muscle weakness, as there was no change in observed EMG parameters.[57] Similarly, in their meta-analysis, Takasaki et al. did not find a negative effect of the continuous use of a lumbar spine orthotic for one to six months. However, the quality of evidence ranged from low to very low.[58]

3.9. Exercise therapy

Exercise therapy encompasses various types of therapy with different underlying mechanistic effects, including stabilization (motor control), strengthening, stretching, and aerobic exercises. Certain techniques, like aerobic exercise, have a more solid physiological background, while others, such as McKenzie therapy[59] (a "biopsychosocial system of musculoskeletal care emphasizing patient empowerment and self--treatment"), have a more conceptual theory influenced by the individuals who introduced that particular type of exercise therapy (Fig. 3). In a systematic meta-analysis of 134 publications (24 reviews, 21 RCTs covering a total of 2685 patients), there was uncertain effectiveness of exercise therapy (including general, stabilization, and McKenzie therapies) for treating acute LBP.[60] There was no demonstrated significant difference in pain or disability reduction between physical therapy and sham ultrasound, usual care, spinal manipulative therapy, advice to stay active, or educational booklets. There was also no significant difference in effectiveness between McKenzie therapy, stabilization exercises, and other types of exercise therapy. Exercise therapy programs varied in length from three days to eight weeks, with a frequency of one to three visits per week and additional home exercise frequency ranging from three times per day to once every hour. However, some of the included reviews were of low quality, which is an important limitation of this systematic review.[60]

Another systematic review published in 2020 concluded there is insufficient evidence that a self-directed McKenzie exercise program for acute LBP results in different outcomes compared to usual medical care.[61] In an updated publication of international clinical guidelines, exercise therapy is recommended for acute LBP in only three out of fourteen guidelines. It is worth noting that guideline recommendations are not solely based on evidence from systematic reviews but also take into account patient preference, clinician experience, cost, availability, and safety, among other factors. These additional aspects could potentially explain the inconsistent recommendations on exercise therapy for ALBP.[62]

3.10. Transcutaneous Electrical Nerve Stimulation (TENS)

Transcutaneous Electrical Nerve Stimulation (TENS) refers to a device placed on the skin surface, either at the site of pain or near nerve bundles proximal to the pain site, to generate pulsed electrical currents intended to stimulate peripheral nerves to reduce pain (Fig. 4). In a meta-analysis of 381 RCTs with a total of 24,532 patients; Johnson et al.[63] found that pain intensity was lower during or immediately after TENS than placebo or other treatments. The researchers concluded that TENS might be beneficial for pain regardless of its characteristics or diagnosis and that TENS should be primarily indicated based on pain symptoms rather than a specific medical diagnosis.

In another review, one low-quality trial with 63 partipants reports that a ~30 min treatment with TENS in an emergency care setting provides clinically beneficial pain relief for moderate to severe acute LBP in the immediate term, as compared to sham TENS. Two other studies which administered a course of TENS over four to five weeks, however, provided inconslusive evidence for the benefit of TENS.[64] Based on the aforementioned studies, patients can be advised to use strong non-painful TENS in or near the area of pain as frequently as needed, and to adjust the pulse frequency, duration, and pattern to their comfort level.

3.11. Cryotherapy & thermotherapy

Studies suggest that both cryotherapy (ice packs) and thermotherapy (hot packs, hot water bottles) have an equal effect on relieving acute LBP. These could strengthen the efficacy of pharmacologic treatment and provide short-term improvements in acute back pain. A hot water

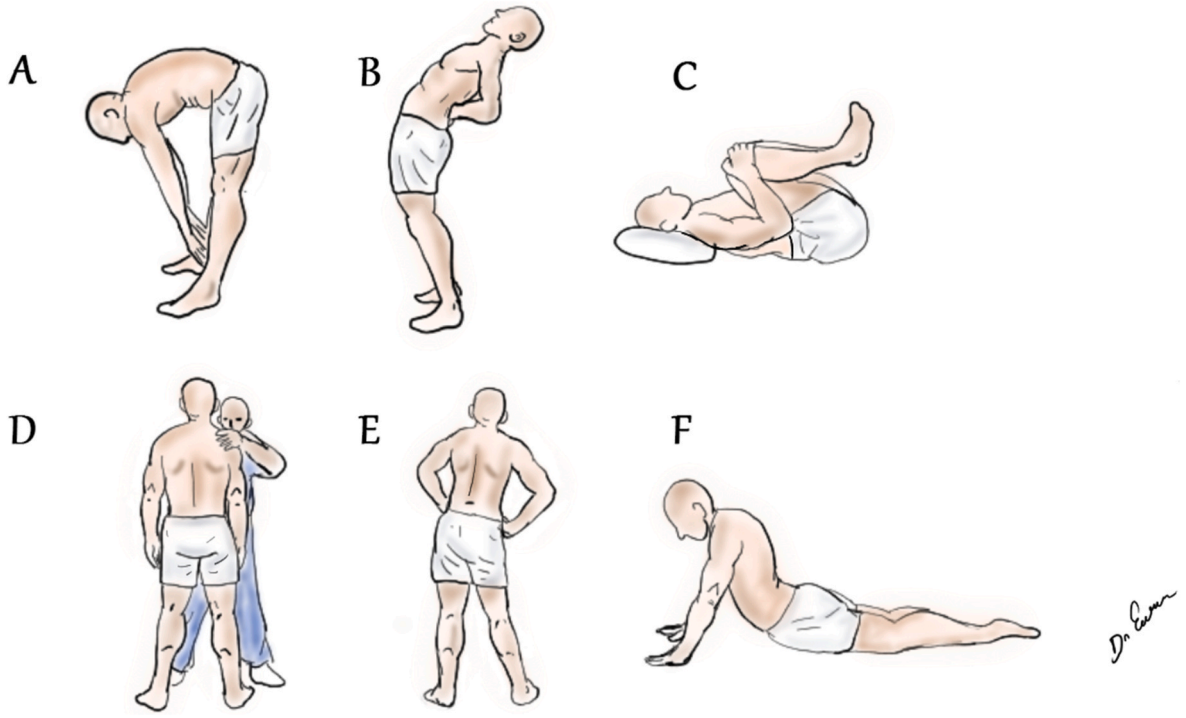

Fig. 3. Hand-drawn representation of dynamic loading strategies applied to the spine in the McKenzie method: (A) flexion in standing; (B) extension in standing; (C) flexion in lying; (D) therapist-assisted side glide in standing, (E) side glide in standing. (F) extension in lying.

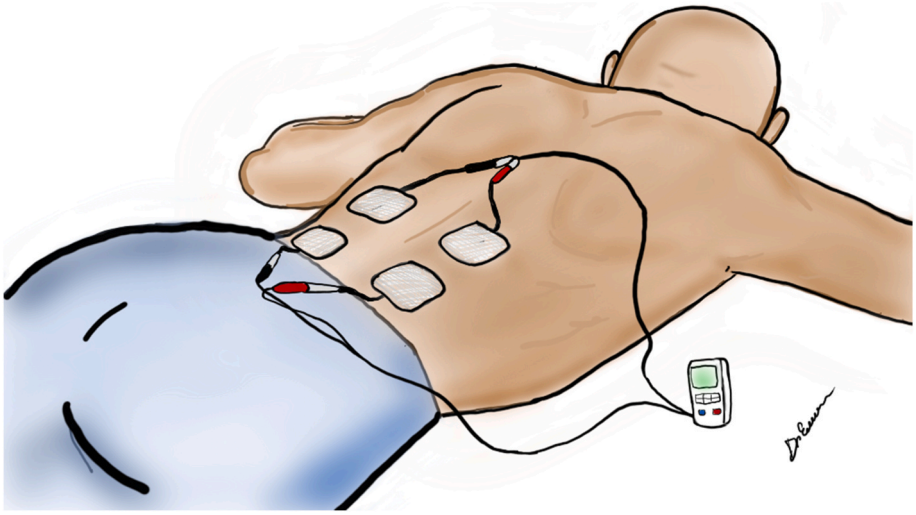

Fig. 4. Picture demonstrating application of tens therapy with tens nerve stimulator.

bottle is advised twice a day for one week, each time for 20 min, and cryotherapy with ice twice a day is advised for one week, each time for 20 min.[61,65–71] An RCT comparing 29 patients with acute LBP, each receiving thermotherapy + naproxen versus cryotherapy + naproxen and naproxen alone for one week, found that patients in the thermotherapy and cryotherapy groups had significantly less pain at one week. Thermotherapy was significantly more effective than cryoptherapy.[65]

3.12. Acupuncture

Several studies suggest that acupuncture may play a role in the treatment of acute back pain. One review (based on five studies) found that acupuncture is more effective than NSAIDs for improving symptoms of acute LBP.[60] (Fig. 5) Lenoir et al.'s meta-analysis reported that acupuncture had a significant positive effect on pain, quality of life, and function at different time intervals.[72] Similarly, a systematic review including 13 RCTs with 707 patients showed that acupuncture led to improvements in pain (measured by VAS score) and reduced medication

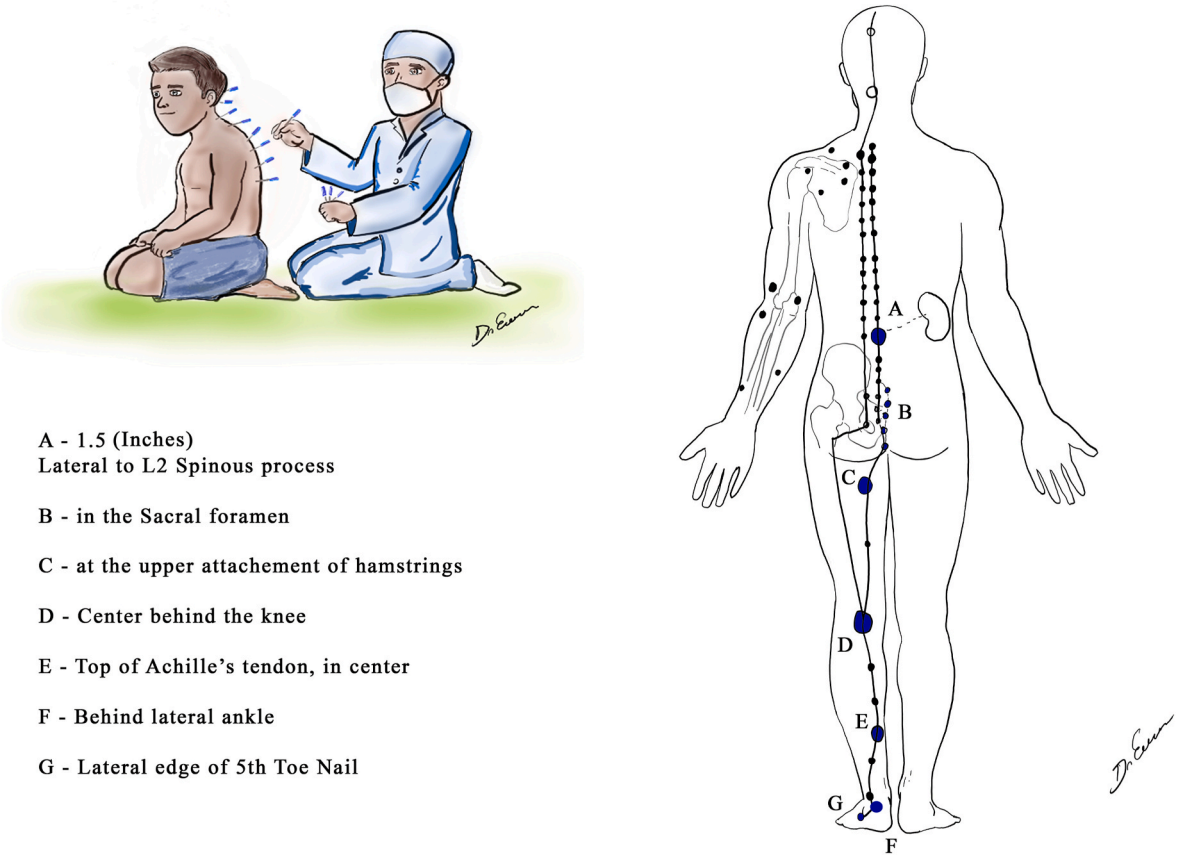

Fig. 5. Various acupuncture points across the back for relief of acute back pain.

Table 3
Final voting for ten consensus statements on the clinical and radiographic diagnosis of acute LBP.

Statement	Voting
(1) Acetaminophen is recommended for first-line pharmacologic treatment of acute low back pain in patients of advanced age, gastrointestinal, cardiovascular, and renal comorbidities, either alone or in conjunction with opioids	(77.8%) Strongly Agree (22.2%) Agree
(2) NSAIDS are a first-line pharmacologic treatment in acute lower back pain. COX2 inhibitors are preferred due to their lower side effect profile.	(66.7%) Strongly agree (33.3%) Agree
(3) Opioids have limited benefits over conservative measures for acute lower back pain. They are indicated when first-line drugs (NSAIDs, Acetaminophen) are contraindicated or not tolerated. A short course of opioids may be considered in patients with intractable pain.	(44.4%) Strongly Agree (33.3%) Agree (22.2%) Neutral
(4) Pregabalin (lyrica) is not recommended for managing acute low back pain without radiculopathy.	(77.8%) Strongly Agree (11.1%) Agree (11.1%) Neutral
(5) Although the evidence is inconclusive, non-benzodiazepine muscle relaxants may be recommended for treatment of spasms associated with acute low back pain.	(33.3%) Strongly Agree (44.4%) Agree (22.2%) Neutral
(6) There is mixed evidence that benzodiazepine muscle relaxants work for acute low back pain. They may be used selectively to reduce severe spasms and pain.	(66.7%) Strongly Agree (22.2%) Agree (11.1%) Neutral
(7) Bed rest for more than 48 h in acute back pain is not recommended. Staying active leads to better symptomatic and functional outcomes in acute low back pain.	(66.6%) Strongly Agree (33.3%) Agree
(8) A lumbar support belt may reduce pain and augment functional status. There is no proven negative effect that lumbosacral orthotics cause muscle weakness and/or deconditioning.	(33.3%) Strongly Agree (22.2%) Agree (33.3%) Neutral (11.1%) Disagree
(9) Thermotherapy and cryotherapy are effective in relieving acute lumbar back pain. TENS (transcutaneous electric nerve stimulation) may be beneficial for the reduction of acute low back pain and has no serious side effects.	(22.2%) Strongly Agree (44.4%) Agree (33.3%) Neutral
10) There is insufficient evidence that exercise programs work in treatment of acute lower back pain	(55.5%) Strongly Agree (22.2%) Agree (22.2%) Neutral
(11) Spinal manipulative therapy may provide short-term (up to 6 weeks) improvement in patients with acute low back pain, comparable with other standard treatments. There is unclear evidence that massage therapy is more effective than inactivity for short-term pain control.	(55.6%) Strongly Agree (33.3%) Agree (0%) Neutral (11.1%) Disagree
(12) There is moderate evidence for the benefit of apunuture in reducing acute low back pain intensity.	(33.3%) Strongly Agree (33.3%) Agree (22.2%) Neutral (11.1%) Disagree

use. A systematic review published by Xiang et al. in 2020 further confirmed there is moderate evidence for the benefit of acupuncture in reducing pain intensity in patients with acute and chronic LBP, with only minor adverse effects.[73] Yet another meta-analysis reported that using more acupuncture needles and increasing the number of treatment sessions resulted in better pain outcomes compared to non-acupuncture treatments.[74]

However, many of the original studies in these meta-analyses had low power, so caution is needed when interpreting these findings. A multicenter RCT of 167 patients conducted at 11 Norwegian general practitioners' offices did not find a statistically significant reduction in time-to-recovery after a single acupuncture session for acute LBP, as compared to standard care (14 days versus 9 days; *p*-value not significant).[75] Further high-quality trials are therefore needed to strengthen evidence for the use of acupuncture in the treatment of acute LBP.

3.13. Massage and Spinal Manipulative Therapy

While massage is often considered an adjunct or complementary treatment to prepare the patient for physical therapy, exercise, or other interventions, it is rarely the main treatment used. Current evidence does not provide a clear indication regarding whether massage is effective for short-term lower back pain relief.[76] Although not evidence-based, some guidelines include massage in the treatment of acute LBP.[39]

A recent meta-analysis including 26 RCTs found that spinal manipulative therapy was associated with significant improvement in pain and function at up to six weeks.[77] Although spinal manipulation does not show a clear advantage over conventional medical treatment for acute low back pain, it is more effective than sham therapy and can be considered as a treatment option. Cost, safety, and patient preferences should be considered when deciding between manipulative and alternative therapies.[78] Others suggest that spinal manipulative therapy, in the setting of a multi-modal approach that includes reassurance, education, postural recommendations, and staying active, may be beneficial for treating acute LBP.[79] 2017 guidelines by Quaseem et al. state there is low-quality evidence that nonpharmacologic treatments such as spinal manipulation should be considered for patients with acute LBP, as most patients tend to improve with time regardless of the type of treatment selected. Therefore, clinicians and patients are encouraged to choose nonpharmacologic treatments based on their preferences and specific circumstances.

3.14. Back schools

Back schools typically refer to educational programs or classes focusing on preventing and managing back pain and related musculoskeletal conditions. These programs are often conducted by healthcare professionals such as physiotherapists, chiropractors, or occupational therapists. Back schools aim to educate individuals about the anatomy and mechanics of the spine and teach proper body mechanics, ergonomics, and exercises to promote a healthy back. In their 2016 systematic review, Poquet and colleagues report that back schools do not appear to be more effective at treating LBP than placebo, sham, physical therapy, myofascial therapy, joint manipulations, or other therapies in the short, intermediate, or long-term. Given the low-quality evidence available, the effectiveness of back schools for acute and subacute nonspecific LBP is therefore uncertain. Although larger, well-designed studies may provide more conclusive results, back schools are not commonly used for acute or subacute LBP, and further research in this area may not be a high priority.[80–82]

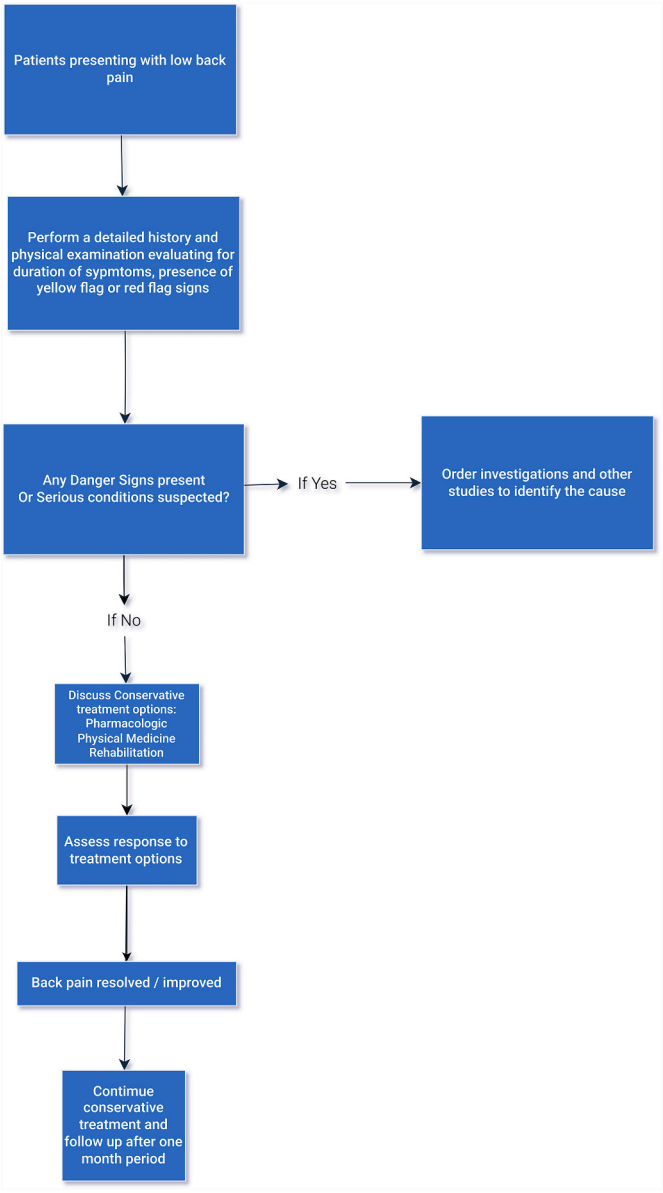

Fig. 6. WFNS Spine Committee recommended step-ladder approach to treatment of patient with acute LBP.

3.15. WFNS Spine Committee Recommendations

Taking this literature in summary and via the two rounds of voting outlined in our methods section (Table 3), the WFNS Spine Committee proposed the following stepladder to manage acute LBP (Fig. 6) and formulated the following twelve consensus statements.

(1) Acetaminophen is recommended for first-line pharmacologic treatment of acute low back pain in patients of advanced age, gastrointestinal, cardiovascular, and renal comorbidities, either alone or in conjunction with opioids.
(2) NSAIDS are a first-line pharmacologic treatment in acute lower back pain. COX2 inhibitors are preferred due to their lower side effect profile.
(3) Opioids have limited benefits over conservative measures for acute lower back pain. They are indicated when first-line drugs (NSAIDs, Acetaminophen) are contraindicated or not tolerated. A short course of opioids may be considered in patients with intractable pain.
(4) Pregabalin (Lyrica) is not recommended for managing acute low back pain without radiculopathy.
(5) Although the evidence is inconclusive, non-benzodiazepine muscle relaxants may be recommended for the treatment of spasms associated with acute low back pain.
(6) There is mixed evidence that benzodiazepine muscle relaxants work for acute low back pain. They may be used selectively to reduce severe spasms and pain.
(7) Bed rest for more than 48 hours in acute back pain is not recommended. Staying active leads to better symptomatic and functional outcomes in acute low back pain.
(8) A lumbar support belt may reduce pain and augment functional status. There is no proven negative effect that lumbosacral orthotics cause muscle weakness and/or deconditioning.
(9) Thermotherapy and cryotherapy are effective in relieving acute lumbar back pain. TENS (transcutaneous electric nerve stimulation) may be beneficial for the reduction of acute low back pain and has no serious side effects.
(10) There is insufficient evidence that exercise programs work in the treatment of acute lower back pain.
(11) Spinal manipulative therapy may provide short-term (up to 6 weeks) improvement in patients with acute low back pain, comparable with other standard treatments. There is unclear evidence that massage therapy is more effective than inactivity for short-term pain control.
(12) There is moderate evidence for the benefit of acupuncture in reducing acute low back pain intensity.

4. Conclusion

Taken together, the WFNS spine committee recommendations provide an up-to-date, evidence-based approach for the pharmacological management, physical medicine, and rehabilitation for acute lower back pain. We advocate for a uniform approach to the treatment of these patients, including proper patient education and utilizing drugs with proven efficacy and minimal side effects: first-line pharmacologic agents are acetaminophen and NSAIDs; muscle relaxants can be used for spasm and pain reduction, and opioids should be minimized. Continued activity, rather than bed rest, is recommended, and lumbar spine orthotics may be used as an adjunct to reduce pain and augment functional status. Thermotherapy, cryotherapy, TENs, spinal manipulative therapy, and acupuncture may all be used as adjuncts to improve acute LBP, based on patient preference and specific circumstances.

Availability of data and materials

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

CRediT authorship contribution statement

Salman Sharif: Writing – original draft, Methodology, Data curation, Conceptualization. **Muhammad Yassar Jazaib Ali:** Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Yeşim Kirazlı:** Data curation. **Ian Vlok:** Writing – review & editing, Data curation, Conceptualization. **Corinna Zygourakis:** Writing – review & editing. **Mehmet Zileli:** Writing – review & editing, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Acknowledgments

The authors would like to acknowledge Dr. Manuel De Jesús Encarnación Ramírez for his help with various hand-drawn illustrations used in this article.

References

1. Blyth FM, Briggs AM, Schneider CH, Hoy DG, March LM. The global burden of musculoskeletal pain—where to from here? *Am J Publ Health*. 2019;109:35–40.
2. Thakral M, Shi L, Foust JB, et al. Persistent pain quality as a novel approach to assessing risk for disability in community-dwelling elders with chronic pain. *J Gerontol: Series A*. 2019;74:733–741.
3. Freo U, Ruocco C, Valerio A, Scagnol I, Nisoli E. Paracetamol: a review of guideline recommendations. *J Clin Med*. 2021;10:3420.
4. Atlas SJ, Deyo RA. Evaluating and managing acute low back pain in the primary care setting. *J Gen Intern Med*. 2001;16:120–131.
5. Urits I, Burshtein A, Sharma M, et al. Low back pain, a comprehensive review: pathophysiology, diagnosis, and treatment. *Curr Pain Headache Rep*. 2019;23:1–10.
6. French SD, Cameron M, Walker BF, Reggars JW, Esterman AJ. Superficial heat or cold for low back pain. *Cochrane Database Syst Rev*. 2006;1.
7. Frerick H, Keitel W, Kuhn U, Schmidt S, Bredehorst A, Kuhlmann M. Topical treatment of chronic low back pain with a capsicum plaster. *Pain*. 2003;106:59–64.
8. Witenko C, Moorman-Li R, Motycka C, et al. Considerations for the appropriate use of skeletal muscle relaxants for the management of acute low back pain. *Pharmacy and therapeutics*. 2014;39:427.
9. Okoli C, Pawlowski SDJI, management. The Delphi method as a research tool: an example. *design considerations and applications*. 2004;42:15–29.
10. PubChem [Internet]. Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information; 2004-. PubChem Compound Summary for CID 1983, Acetaminophen; [cited 2024 Mar. 29]. Available from: https://pubchem.ncbi.nlm.nih.gov/compound/Acetaminophen.
11. Anderson BJ. Paracetamol (Acetaminophen): mechanisms of action. *Pediatric Anesthesia*. 2008;18:915–921.
12. Abdel Shaheed C, Ferreira GE, Dmitritchenko A, et al. The efficacy and safety of paracetamol for pain relief: an overview of systematic reviews. *Med J Aust*. 2021;214:324–331.
13. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. 2007;147:478–491.
14. Uk NGC. *Low Back Pain and Sciatica in over 16s: Assessment and Management*. 2016.
15. *Low Back Pain EBM Guidelines*; 2019. https://www.ebmguidelines.com/ebmg/ltk.free?p_artikkeli=ebm00435. Accessed July 2, 2020.
16. Wong J, Côté P, Sutton D, et al. Clinical practice guidelines for the noninvasive management of low back pain: a systematic review by the Ontario Protocol for Traffic Injury Management (OPTIMa) Collaboration. *Eur J Pain*. 2017;21:201–216.
17. Miki K, Ikemoto T, Hayashi K, et al. Randomized open-labbel non-inferiority trial of acetaminophen or loxoprofen for patients with acute low back pain. *J Orthop Sci*. 2018;23:483–487.
18. Nadler SF, Steiner DJ, Erasala GN, et al. *Continuous Low-Level Heat Wrap Therapy Provides More Efficacy than Ibuprofen and Acetaminophen for Acute Low Back Pain*. LWW; 2002.
19. Friedman BW, Irizarry E, Chertoff A, et al. Ibuprofen plus acetaminophen versus ibuprofen alone for acute low back pain: an emergency department–based randomized study. *Acad Emerg Med*. 2020;27:229–235.
20. Koes B, Schreijenberg M, Tkachev A. Paracetamol for low back pain: the state of the research field. *Expet Rev Clin Pharmacol*. 2020;13:1059–1066.
21. Williams CM, Maher CG, Latimer J, et al. Efficacy of paracetamol for acute low-back pain: a double-blind, randomised controlled trial. *Lancet*. 2014;384:1586–1596.
22. Bindu S, Mazumder S, Bandyopadhyay U. Non-steroidal anti-inflammatory drugs (NSAIDs) and organ damage: a current perspective. *Biochem Pharmacol*. 2020;180, 114147.
23. Van Tulder M, Becker A, Bekkering T, et al. European guidelines for the management of acute nonspecific low back pain in primary care. *Eur Spine J*. 2006;15:s169.
24. Plapler PG, Scheinberg MA, Ecclissato CdC, Bocchi de Oliveira MF, Amazonas RB. Double-blind, randomized, double-dummy clinical trial comparing the efficacy of ketorolac trometamol and naproxen for acute low back pain. *Drug Des Dev Ther*. 2016:1987–1993.
25. Roelofs PD, Deyo RA, Koes BW, Scholten RJ, Van Tulder MW. Nonsteroidal anti-inflammatory drugs for low back pain: an updated Cochrane review. *Spine*. 2008;33:1766–1774.
26. Enthoven WT, Roelofs PD, Deyo RA, et al. Non-steroidal anti-inflammatory drugs for chronic low back pain. *Cochrane Database Syst Rev*. 1996;2016.
27. van der Gaag M, van den Berg D, Ising H. CBT in the prevention of psychosis and other severe mental disorders in patients with an at risk mental state: a review and proposed next steps. *Schizophr Res*. 2019;203:88–93.
28. Phillips JK, Ford MA, Bonnie RJ. *Pain Management and the Opioid Epidemic: Balancing Societal and Individual Benefits and Risks of Prescription Opioid Use*. 2017.
29. Deyo RA, Von Korff M, Duhrkoop D. Opioids for low back pain. *Bmj*. 2015:350.
30. Jones CM, Day RO, Koes BW, et al. Opioid analgesia for acute low back pain and neck pain (the OPAL trial): a randomised placebo-controlled trial. *Lancet*. 2023;402:304–312.
31. Group TOPLBPW. *Evidence-informed Primary Care Management of Low Back Pain: Clinical Practice Guideline*. Alberta, Canada: Alberta Institute of Health Economics Canada; 2015.
32. Elleuch M, El Maghraoui A, Griene B, Nejmi M, Ndongo S, Serrie A. Formalized consensus: clinical practice recommendations for the management of acute low back pain of the African patient. *The Pan African Medical Journal*. 2015;22:240.
33. Chou R. The clinic. Low back pain. *Ann Intern Med*. 2014;160. Itc6-1.
34. Sakai Y, Ito K, Hida T, Ito S, Harada A. Pharmacological management of chronic low back pain in older patients: a randomized controlled trial of the effect of pregabalin and opioid administration. European spine journal. In: *Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*. vol. 24. 2015:1309–1317.
35. Mathieson S, Maher CG, McLachlan AJ, et al. Trial of pregabalin for acute and chronic sciatica. *N Engl J Med*. 2017;376:1111–1120.
36. Taguchi T, Igarashi A, Watt S, et al. Effectiveness of pregabalin for the treatment of chronic low back pain with accompanying lower limb pain (neuropathic component): a non-interventional study in Japan. *J Pain Res*. 2015:487–497.
37. Chou R, Deyo R, Friedly J, et al. Nonpharmacologic therapies for low back pain: a systematic review for an American College of Physicians clinical practice guideline. *Ann Intern Med*. 2017;166:493–505.
38. Cashin AG, Folly T, Bagg MK, et al. Efficacy, acceptability, and safety of muscle relaxants for adults with non-specific low back pain: systematic review and meta-analysis. *bmj*. 2021:374.
39. Qaseem A, Wilt TJ, McLean RM, Forciea MA, Physicians* CGCotACo. Noninvasive treatments for acute, subacute, and chronic low back pain: a clinical practice guideline from the American College of Physicians. *Ann Intern Med*. 2017;166:514–530.
40. de Campos TF. Low back pain and sciatica in over 16s: assessment and management NICE Guideline [NG59]. *J Physiother*. 2017;63:120.
41. Abdel Shaheed C, Maher C, Williams K, McLachlan A. Efficacy and tolerability of muscle relaxants for low back pain: systematic review and meta-analysis. *Eur J Pain*. 2017;21:228–237.
42. Friedman BW, Irizarry E, Solorzano C, et al. Diazepam is no better than placebo when added to naproxen for acute low back pain. *Ann Emerg Med*. 2017;70:169–176.e1.
43. Stochkendahl MJ, Kjaer P, Hartvigsen J, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. *Eur Spine J*. 2018;27:60–75.
44. Guevara-Lopez U, Covarrubias-Gomez A, Elias-Dib J, Reyes-Sanchez A, Rodriguez-Reyna T. Consensus group of practice parameters to manage low back P. Practice guidelines for the management of low back pain. Consensus group of practice parameters to manage low back pain. *Cir Cir*. 2011;79:264–279.
45. Innovation NAfC. Management of people with acute low back pain: model of care. *Chatswood*. 2016.
46. Stochkendahl MJ, Kjaer P, Hartvigsen J, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. *Eur Spine J*. 2018;27:60–75.
47. Van Tulder M, Custers J, de Bie R. *Ketenzorgrichtlijn Aspecifieke Lage Rugklachten*. Belgrade: KKCZ; 2010.
48. Di Mattia F, Tejani S, Hall T. Bed rest for sciatica: a closer look at the evidence. *J Orthop Sports Phys Ther*. 2018;48:436–438.
49. Dahm KT, Brurberg KG, Jamtvedt G, Hagen KB. Advice to rest in bed versus advice to stay active for acute low-back pain and sciatica. *Cochrane Database Syst Rev*. 2010, Cd007612.
50. Rozenberg S, Delval C, Rezvani Y, et al. *Bed Rest or Normal Activity for Patients with Acute Low Back Pain: A Randomized Controlled Trial*. LWW; 2002.
51. Malmivaara A, Häkkinen U, Aro T, et al. The treatment of acute low back pain—bed rest, exercises, or ordinary activity? *N Engl J Med*. 1995;332:351–355.
52. Casazza BA. Diagnosis and treatment of acute low back pain. *Am Fam Physician*. 2012;85:343–350.
53. Hagen KB, Hilde G, Jamtvedt G, Winnem M. Bed rest for acute low-back pain and sciatica. *Cochrane Database Syst Rev*. 2004, Cd001254.
54. Casazza BA, Young JL, Herring SA. The role of exercise in the prevention and management of acute low back pain. *Occupational medicine (Philadelphia, Pa*. 1998;13:47–60.
55. Calmels P, Queneau P, Hamonet C, et al. *Effectiveness of a Lumbar Belt in Subacute Low Back Pain: An Open, Multicentric, and Randomized Clinical Study*. LWW; 2009.
56. Anders C, Hübner A. Influence of elastic lumbar support belts on trunk muscle function in patients with non-specific acute lumbar back pain. *PLoS One*. 2019;14, e0211042.
57. Azadinia F, Takamjani EE, Kamyab M, Parnianpour M, Cholewicki J, Maroufi N. Can lumbosacral orthoses cause trunk muscle weakness? A systematic review of literature. *Spine J*. 2017;17:589–602.
58. Takasaki H, Miki T. The impact of continuous use of lumbosacral orthoses on trunk motor performance: a systematic review with meta-analysis. *Spine J*. 2017;17:889–900.
59. McKenzie R, May S. *The Lumbar Spine: Mechanical Diagnosis & Therapy*. vol. 2. Spinal Publications New Zealand; 2003.
60. Lee J-H, Choi T-Y, Lee MS, Lee H, Shin B-C, Lee H. Acupuncture for acute low back pain: a systematic review. *Clin J Pain*. 2013;29:172–185.
61. Kreiner DS, Matz P, Bono CM, et al. Guideline summary review: an evidence-based clinical guideline for the diagnosis and treatment of low back pain. *Spine J*. 2020;20:998–1024.

62. Oliveira CB, Maher CG, Pinto RZ, et al. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. *Eur Spine J*. 2018;27:2791–2803.
63. Johnson MI, Paley CA, Jones G, Mulvey MR, Wittkopf PG. Efficacy and safety of transcutaneous electrical nerve stimulation (TENS) for acute and chronic pain in adults: a systematic review and meta-analysis of 381 studies (the meta-TENS study). *BMJ Open*. 2022;12, e051073.
64. Binny J, Wong NLJ, Garga S, et al. Transcutaneous electric nerve stimulation (TENS) for acute low back pain: systematic review. *Scandinavian journal of pain*. 2019;19: 225–233.
65. Dehghan M, Farahbod F. The efficacy of thermotherapy and cryotherapy on pain relief in patients with acute low back pain, a clinical trial study. *J Clin Diagn Res: J Clin Diagn Res*. 2014;8:LC01.
66. Kettenmann B, Wille C, Lurie-Luke E, Walter D, Kobal G. Impact of continuous low level heatwrap therapy in acute low back pain patients: subjective and objective measurements. *Clin J Pain*. 2007;23:663–668.
67. Mayer JM, Ralph L, Look M, et al. Treating acute low back pain with continuous low-level heat wrap therapy and/or exercise: a randomized controlled trial. *Spine J*. 2005;5:395–403.
68. Nadler SF, Steiner DJ, Erasala GN, Hengehold DA, Abeln SB, Weingand KW. Continuous low-level heatwrap therapy for treating acute nonspecific low back pain. *Arch Phys Med Rehabil*. 2003;84:329–334.
69. Nadler SF, Steiner DJ, Petty SR, Erasala GN, Hengehold DA, Weingand KW. Overnight use of continuous low-level heatwrap therapy for relief of low back pain. *Arch Phys Med Rehabil*. 2003;84:335–342.
70. Shakoor M, Rahman M, Moyeenuzzaman M. Effects of deep heat therapy on the patients with chronic low back pain. *Mymensingh Med J: MMJ*. 2008;17:S32–S38.
71. Tao X, Bernacki EJ. A randomized clinical trial of continuous low-level heat therapy for acute muscular low back pain in the workplace. *J Occup Environ Med*. 2005: 1298–1306.
72. Lenoir D, De Pauw R, Van Oosterwijck S, Cagnie B, Meeus M. Acupuncture versus sham acupuncture: a meta-analysis on evidence for longer-term effects of acupuncture in musculoskeletal disorders. *Clin J Pain*. 2020;36:533–549.
73. Xiang Y, He J-y, Tian H-h, Cao B-y, Li R. Evidence of efficacy of acupuncture in the management of low back pain: a systematic review and meta-analysis of randomised placebo-or sham-controlled trials. *Acupunct Med*. 2020;38:15–24.
74. MacPherson H, Maschino AC, Lewith G, Foster NE, Witt CM, Vickers AJ. Characteristics of acupuncture treatment associated with outcome: an individual patient meta-analysis of 17,922 patients with chronic pain in randomised controlled trials. *PLoS One*. 2013;8, e77438.
75. Su X, Qian H, Chen B, et al. Acupuncture for acute low back pain: a systematic review and meta-analysis. *Ann Palliat Med*. 2021;10:3924–3936.
76. Furlan AD, Giraldo M, Baskwill A, Irvin E, Imamura M. Massage for low-back pain. *Cochrane Database Syst Rev*. 2015(9).
77. Paige NM, Miake-Lye IM, Booth MS, et al. Association of spinal manipulative therapy with clinical benefit and harm for acute low back pain: systematic review and meta-analysis. *JAMA*. 2017;317:1451–1460.
78. Smith MS, Olivas J, Smith K. Manipulative therapies: what works. *Am Fam Physician*. 2019;99:248–252.
79. Bussières AE, Stewart G, Al-Zoubi F, et al. Spinal manipulative therapy and other conservative treatments for low back pain: a guideline from the Canadian chiropractic guideline initiative. *J Manipulative Physiol Therapeut*. 2018;41:265–293.
80. Poquet N, Lin CWC, Heymans MW, et al. Back schools for acute and subacute non-specific low-back pain. *Cochrane Database Syst Rev*. 2016(4).
81. Saragiotto BT, Machado GC, Ferreira ML, et al. Paracetamol for low back pain. *Cochrane Database Syst Rev*. 1996;2019.
82. Van Wambeke P, Desomer A, Ailiet L, et al. Low back pain and radicular pain: assessment and management. *KCE Report*. 2017:287.