The Therapeutic Management of Back Pain With and Without Sciatica in the Emergency department: A Systematic review

Running title

Back pain in the Emergency Department

Introduction

There were 23.8 million attendances in Emergency Departments (ED) in England in 2017-18 (1). The number of patients re-attending within 7 days in 2018-18 was 1.7 million; this is an overall increase since 2008-09 of 86 percent. This is impacting on the National Health Service (NHS) constitution target of 95 percent of patients spending 4 hours or less in the ED, which has not been met since 2013-14 (1).

There are no specific data pertaining to numbers of patients with low back pain, with or without sciatica, attending the ED in the United Kingdom (UK) due to recording of diagnostic categories in national statistics not specifying the anatomical region of musculoskeletal problems. Epidemiological data from the United States of America (USA) have reported an estimated 2.06 million episodes of low back pain per year, accounting for 3% of all emergency department visits (2). In Australia, back pain is reported to be in the top 10 conditions presenting in the ED (3). In most ED back pain cases , despite increasing use of diagnostic tests, such as plain film radiographs, Magnetic Resonance Imaging (MRI) scans and blood tests with direct costs estimated at US$819 million (4), the specific cause of patient symptoms is never established (5, 6). The lack of diagnosis and management guidelines results in significant physical and emotional burden to the patient and challenge to the treating physician (3). It is recommended specific imaging modalities be reserved exclusively to exclude serious conditions (5).

In the absence of specific guidance, there is evidence to suggest the existence of varied and inconsistent management of back pain with or without sciatica in the ED (6). Although guidelines

suggest opioids be reserved for severe pain (7), evidence suggests their use in the ED has increased and the use of non-steroidal anti-inflammatories has decreased (4, 5).

Physiotherapy management of musculoskeletal conditions, has been recommended as a potentially clinically and cost effective addition to the ED Multi-Disciplinary Team (MDT) (8). Physiotherapists as primary contact practitioners in the ED have demonstrated effective management of back pain with or without sciatica, with significantly less ED length of stay (EDLOS) and fewer imaging requests than medical staff (9).

The importance of establishing some recommendations for the management of low back pain with or without sciatica in the absence of clinical red flags or serious pathology in the ED would be helpful to patients and clinicians. A MDT approach to health care is becoming increasingly commonplace and there is a growing body of evidence suggesting that inter-professional teamwork in the ED could be beneficial in reducing LOS and unnecessary imaging (8-10).

Objectives

The purpose of this study was to review the available literature to determine the evidence base for therapeutic management of adults presenting with back pain with or without sciatica in the ED. The outcomes of interest included pain, function, EDLOS, adverse events and continued resource utilisation such as re-attendance in the ED.

Method

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were taken into account to enhance the quality of this review. The review protocol was made publicly available on the PROSPERO website.

Search Strategy

The following databases were searched: MEDLINE [via IVIDSP 1946-], EMBASE [via EBSCOhost 1974-], SCOPUS [1996-], CINAHL [via EBSCOhost 1981-], ZETOC [1993-], PubMed, The Cochrane Library

(Cochrane Database of Systematic Reviews), Web of Science, Open Grey and ETHOS. Searches were from inception to August 2018. Search terms were (Low Back Pain) OR (Lumbago) OR (Sciatica) OR (Radiculopathy) AND (Emergency Department) OR (Accident and Emergency) OR (A&E) AND (Treatment) OR (Management) including MeSH.

Inclusion and exclusion criteria

Included were, peer reviewed, original research in the English Language. All studies including adult patients (> 16 years) with low back pain in the ED with validated outcome measures were included. Radicular leg pain could be present or absent. All therapeutic interventions were evaluated. Pilot studies were included.

Studies were excluded if they addressed the management of patients with red flags suggestive of serious spinal pathologies such as cauda equina syndrome, cancer or infection, rheumatoid or inflammatory arthropathies, pregnancy, low back pain resulting from major trauma and abdominal aortic aneurysm. Studies set in primary care, GP surgeries, hospital wards and emergency transport were excluded. Studies evaluating diagnostic and imaging interventions were excluded. Other exclusions included systematic and narrative reviews, clinical commentaries, editorials, grey literature or studies from non-peer reviewed journals. Reference lists of the full text articles were checked to ensure any articles not captured in the electronic search were included. No publication date limits were set.

Study selection and quality assessment scheme

Two reviewers (JA/NR) searched the databases independently. Articles were reviewed for eligibility based on their title, abstract and then full text. Non-eligible studies were excluded and duplicate articles were removed (Fig. 1).

Data extraction

Two reviewers (JA/NR) extracted key data from the articles independently and third and fourth reviewers (PG/GY) acted as arbiters. Key data were summarised to allow comparison and contextualisation of results (Tables 1 and 2).

Assessment of Study Quality

The final studies were appraised for methodological quality by the two reviewers (JA/NR) independently using the Downs and Black checklist (11), any disagreement in scores resolved by discussion. Third and fourth reviewers (GY/PG) were available to resolve disagreements; however, this was not required. The Downs and Black checklist has a Spearman Correlation Coefficient 0.90 for assessing the methodological quality of randomized and non-randomized studies (12). The checklist has five sections: reporting, external validity, internal validity, selection bias and power. Each section has a maximum score of 11, 3, 7, 6 and 5 points, respectively, or total score of 32 points.

Results

An initial search identified 2384 articles on a variety of topics on the ED management of acute low back pain with or without sciatica. After removing duplicates and excluding those not matching the inclusion criteria, a total of 26 articles were identified including 5429 patients, spanning eight countries (Table 1 and 2). The outcome measures, interventions and comparators used in these trials were heterogeneous, therefore, a narrative review was deemed be the most appropriate method to report the findings.

Out of the final 26 studies there were 19 randomised control trials, 2 randomised studies (no control), one randomised control pilot study, two cohort studies, one cohort pilot study and one retrospective audit.

Figure 1: Flowchart depicting the database search and article elimination process, along the guidelines of PRISMA.

Table 1: Pharmacological interventions PICOS

Table 2: Non-pharmacological interventions PICOS

Methodological quality of the trials

Methodological quality is summarised in Tables 3 and 4. Study scores ranged from 16 to 31 with a mean score of 24 out of a possible 32 and given corresponding quality levels: excellent (27-32), good (21-26), fair (15-20) and poor (<15) adapted from previously documented ratings (13).

Randomisation and Concealment

Computer generated randomisation was used in 20 studies, one study (14) used manually shuffled sealed, opaque envelopes and two studies (15, 16) did not state how randomisation occurred.

Sealed opaque envelopes were used to conceal randomisation in nine studies (14, 16-22). Identical or labelled syringes or masked tablets were provided immediately after randomisation by the pharmacist in seven studies (23-27).

Intention-to-Treat Analysis

Two studies excluded from their analysis participants with missing data who either withdrew from the study or failed to record outcome (18, 28) and one (15) did not clarify data analysis approach following drop outs.

Blinding

Of the seventeen pharmacological RCTs double blinding occurred in fifteen. In two studies (18, 23)only the patient was blinded to treatment. In two studies (29, 30) multiple superficial injections were compared to a single infusion and no blinding occurred.

Of the acupuncture studies one (31) attempted to blind the participants by providing sham acupuncture, one (32) blinded the outcome assessors and acupuncturists to pharmacological therapy and one (14) made no attempt at blinding. The outcome assessors only were blinded in the physiotherapy intervention study (33). This lack of blinding increases the risk of bias in these studies.

Table 3: Downs and Black scores of pharmacological studies.

Table 4: Downs and Black scores of non-pharmacological studies.

Pharmacological studies

Twenty-one studies, including 3482 patients, investigated the pharmacological management of back pain in the ED. Mean methodological score was 26 (Table 3). There were n=11 studies of excellent quality. N=2 (17, 20) found corticosteroids to be beneficial in LBP with sciatica, but not LBP without sciatica. When considering the use of oral and topical non-steroidal anti-inflammatory drugs (NSAIDs) in the management of LBP without sciatica n=3 studies (23, 24, 26) found Naproxen to be superior alone when compared to combination pharmacotherapy, the addition of paracetamol to ibuprofen compared to ibuprofen alone did not improve outcomes after one week(34), and n=1 study found the application of Ketoprofen gel in addition to intravenous (IV) Dexketoprofen to be superior to placebo (27). IV Dexketoprofen NSAID) was as effective as IV Paracetamol and IV Morphine in patients with LBP without neurological deficit(19) in n=1 study. N=4 (23, 24, 26, 35) studies concluded that muscle relaxants are not helpful in the management of LBP without sciatica and there were no studies investigating the use of muscle relaxants in LBP with sciatica. IV Morphine was found to be superior to IV paracetamol in patients with LBP with sciatica and the same adverse effect profile in n=1 study (21). N=1 study found that at least fifty trigger point injections of a combination of Thiocolchicoside, Lidocaine and Tenoxicam was more effective in reducing pain up to one hour compared so a single dose of IV Dexketoprofen (29) (Table 5).

Studies included male and female adults aged 18 and over. Thirteen studies included only patients with acute and severe pain identified by duration of pain and minimum score on a pain Visual Analogue Scale (VAS) or numerical pain rating scale (NPRS), however minimum scores were

inconsistent throughout the studies. Six studies excluded patients without sciatica (17, 20, 21, 28, 29, 36), twelve studies excluded patients with sciatica (18, 19, 23-27, 30, 34, 35, 37) and the remaining studies did not specify the presence or absence of sciatica in their inclusion or exclusion criteria.

All studies recorded short-term outcomes measures ranging from 15 minutes to 7 days including pain severity, function, adverse events, use of rescue analgesia, EDLOS, patient satisfaction and healthcare utilization. Long-term outcomes were measured in 16 studies ranging from one week to three months.

Table 5: Grouped positive and negative finding of pharmacological studies

Non-Pharmacological studies

Five studies, (2034 patients) investigated the non-pharmacological management of back pain in the ED. Mean methodological score was 21.6 (Table 4). Two fair quality studies (24, 35) concluded that Physiotherapy assessment and treatment was superior to standard care on discharge and at 1 month. One excellent quality study (32) concluded that acupuncture does not enhance pain relief when alone or combined with pharmacological management and two acupuncture studies (16, 31) of fair quality concluded that acupuncture is effective for short-term pain relief (Table 6).

Studies included male and female adults aged 18 and over. Only one study specified a minimum pain score for inclusion criteria. Two physiotherapy studies (24, 35) included patients with back pain with or without radicular pain. Three acupuncture studies included patients with back pain only.

All studies recorded short-term outcomes and four studies recorded follow up outcomes ranging from 48 hours (32) to 6 months (24). The outcome measures focused on pain, function and adverse events. Two studies (32, 35) considered EDLOS and ongoing resource use, such as admission rate and rescue analgesia.

Table 6: Grouped positive and negative finding of non-pharmacological studies

Discussion

The purpose of this systematic review was to determine the evidence base for the therapeutic management of adults attending the ED with back pain with or without sciatica.

Low back pain with or without sciatica is recognized as a major financial burden because of the resources needed for its management, including imaging, increased ED length of stay, ongoing analgesic management, healthcare utilisation and potential hospital ward admission(4).

Despite the studies reviewed spanning eight countries there are no data to determine the prevalence or management of LBP in the ED in the UK.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDS)

Findings from this review that NSAIDs are as effective alone than when combined with other pharmacology (23, 26, 27, 38, 39) are consistent with the recommendations of others (40, 41). It is recommended that oral NSAIDs should be considered first in the ED management of patients with back pain and that the addition of opioids or muscle relaxants do not significantly affect pain-relieving qualities (40). The National Institute of Clinical Excellence (NICE) (41) goes further and states that patients with LBP should be managed in primary care without the need to burden an already overstretched ED.

None of the studies comparing Naproxen to muscle relaxants sub-classified patients into those with spasm and those without. Therefore, the effect of adding muscle relaxants in the presence of muscle spasm was not established.

Two studies of varied quality indicate that IV NSAIDs are as effective as other parenteral drugs without a significant adverse effect profile (19, 28); however, no studies compare the efficacy of IV to oral in terms of pain relief, EDLOS and ongoing resource use.

One high quality study (27) concluded that adding Ketoprofen gel to IV dexketoprofen significantly improved pain relief at 30mins; however, functional outcomes, long-term outcomes or EDLOS were not reported.

Opioids

While there is no doubt that IV morphine is effective in the management of back pain in the ED, there is conflicting evidence regarding its superiority (19, 21). Both studies reported similar adverse events including nausea, vomiting and dizziness. Due to rare but unpredictable serious adverse events (42), patients require lengthy monitoring post IV administration of morphine resulting in potentially higher EDLOS than that of other analgesia. Unfortunately, neither studies included EDLOS as an outcome measure making it impossible to determine this.

Acetaminophen-codeine is found to be of no greater benefit to pain relief when combined with NSAIDs and has a greater adverse effect profile (23, 39) making it a poor choice of management.

Tapentadol and Tramadol were both effective resulting in significant pain reduction after 7 days and 3 months in one moderate quality study (43). Patients who received Tapentadol demonstrated reduced re-attendance rates 30 days following discharge.

Although there seems to be a place for opioids in this population these results are in line with clinical guidance advising use be reserved for severe and disabling pain that is not controlled with first line management (7). Essential considerations for prescribing opioids on discharge must include increasing rates of opioid prescription in primary care and the association with abuse, serious adverse effects and premature death (38), particularly in this patient group where a significant proportion will continue to access healthcare in the long term.

Corticosteroids

For patients presenting with back pain in the absence of neurological deficit oral prednisolone was not effective in the reduction of pain and resulted in more medical management and greater

number of days off work (34). For patients presenting with back pain without radicular symptoms there were no benefits to intra-muscular (IM) methylprednisolone when administered in addition to standard care (28).

For patients presenting with radicular back pain in the ED some benefits pertaining to the use of corticosteroids have been documented. IV dexamethasone significantly reduced 24-hour pain and EDLOS (19) in one high quality study, while IM methylprednisolone significantly reduced disability and analgesic use in a study with poor selection bias and no reported power calculation. This observation needs to be investigated further, perhaps leading to the stratification of low back patients based on radicular symptoms.

Physiotherapy

Physiotherapists have become increasingly common in the ED team, particularly in the UK, USA and Australia (12).

The utilization of physiotherapists with advanced competencies as first contact practitioners in the ED has shown positive results in one moderate quality study (35). Patients assessed by advanced musculoskeletal physiotherapists had less EDLOS and were less likely to be admitted to a hospital ward compared to patients seen by doctors or nurse practitioners, without evidence of re-attendance.

Implementing physiotherapy management in the ED for patients with and without sciatica resulted in significantly improved pain and function on discharge and 1 month follow up compared to usual care (24). The intervention group received advice, pain education and reassurance as well as practical guidance on returning to usual activities and coping strategies in line with NICE guidance (41). Although this study supports early physiotherapy intervention in the ED due to difficulty blinding participants and physiotherapists and a lack of power calculation, a moderate risk of bias must be considered when interpreting these results.

Acupuncture

In one high quality study, acupuncture was found to be of no benefit in addition to pharmacotherapy (32). The group receiving acupuncture in isolation required significantly more rescue analgesia and were more likely to be admitted onto a hospital ward. These findings suggest that acupuncture is not likely to enhance the management of back pain in the ED.

Strengths and limitations of the study

This was a rigorous systematic review following PRISMA guidance with prior publication in PROSPERO. Two reviewers independently searched the databases, extracted the data and reviewed the literature for quality with third and fourth arbiters. An evidence-based risk of bias tool was used to evaluate the heterogeneous studies and a narrative approach to reporting the findings was taken according to recommendations.

Despite this, limitations existed. The reviewers were not blinded to publication information (e.g. authors and institution names). Despite our best attempt at being systematic and complete in our searches, we excluded five articles that were not in English. These two issues potentially introduce cultural, language and/or publication bias.

Conclusion

This review has identified that there is a lack of understanding of the prevalence of back pain attendances in the UK ED. Prior to undertaking trials investigating the management of LBP in the ED in the UK basic epidemiological data on numbers attending is required.

The available literature regarding the therapeutic management of acute low back pain with or without sciatica in the ED has been summarised in this review. The evidence suggests for patients presenting with back pain and no radicular symptoms Naproxen should be considered as first line pain relief. IV morphine, paracetamol or dexketoprofen could be considered in this group in rare cases of severe pain where first line treatment is unsuccessful.

For patients presenting with radicular symptoms, first line analgesic management is not clear from the literature. In cases of severe pain IV corticosteroids could be considered.

The literature indicates physiotherapy assessment and interventions may be effective in improving EDLOS, pain and functional outcomes in LBP patients with and without radicular symptoms. However, in order to establish whether physiotherapy can be recommended as part of an evidence-based management protocol for the treatment of acute LBP with or without sciatica in the ED, high quality trials are required.

Further studies to investigate the pharmacological management of LBP without radicular symptoms are not recommended.

Ethic approval and consent to participate

Not applicable.

Conflict of interests

The authors declare that they have no conflicts of interest.

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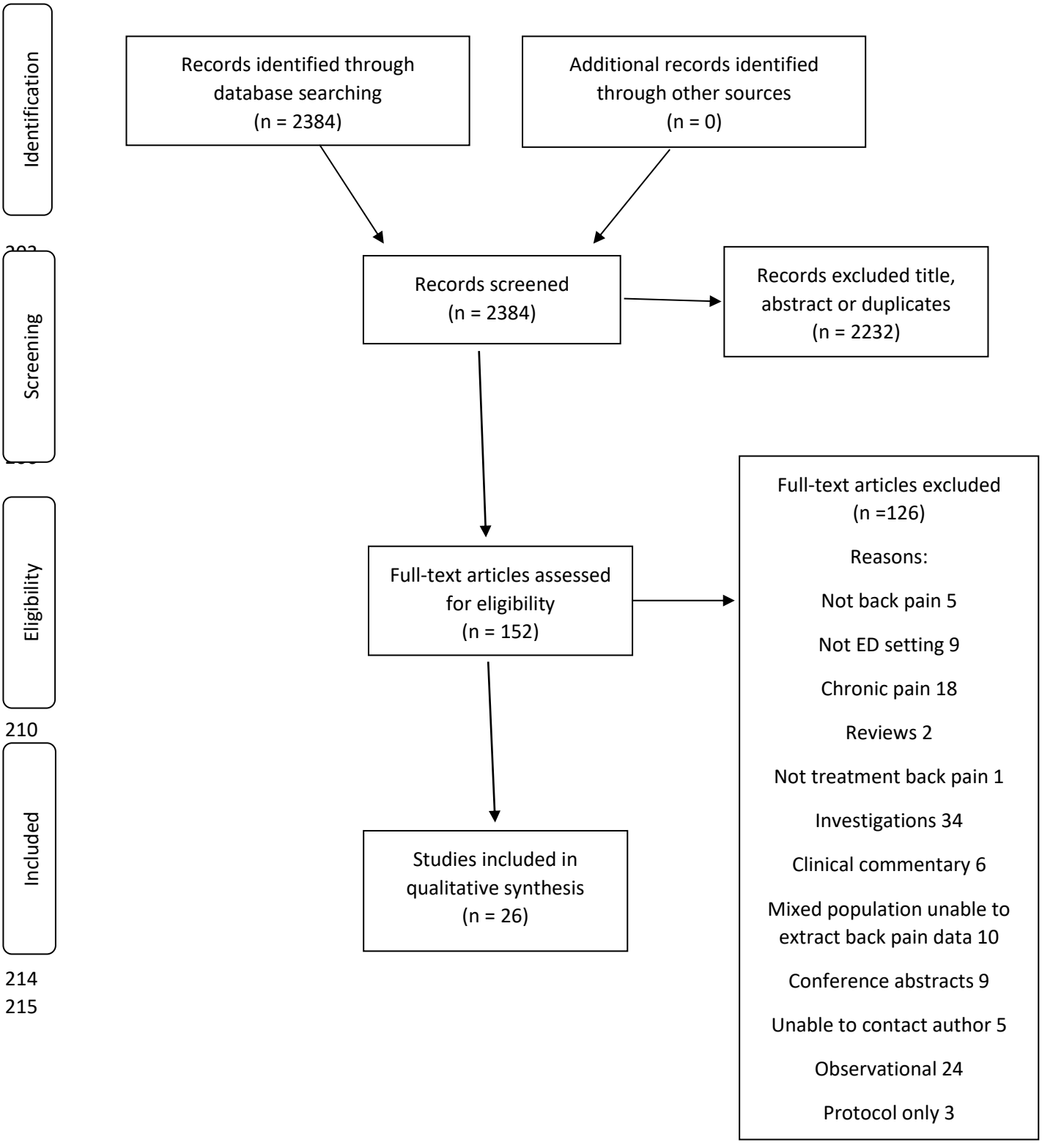
Figure 1: Flowchart depicting the database search and article elimination process, along the guidelines of PRISMA.



216 **Table 1: Pharmacological interventions PICOS**

Authors, publication year, country, study design	Participants	Interventions	Comparisons	Outcomes
Akbas, et al (2019, Turkey) Non-blinded randomised study (29)	N=120 Median age: 36 Female: n=56 Acute LBP with confirmed disc herniation and positive straight leg raise	Group 1: >50 mesotherapy injections 1-3mm depth of 0.1 to 0.2cc. 2mg thiocolchicoside, 16.2mg lidocaine, 5mg tenoxicam Minimum 50 injections	Group 2: 50mg dexketoprofen in 100cc isotonic solution IV for 5 minutes.	Mean delta values of pain VAS score reduction: 15 minutes: G1 2.13 (SD 1.46), G2 1.32 (SD 0.85) p=0.001 30 minutes: G1 3.70 (SD 1.98), G2 2.18 (SD 1.08) p<0.001 60 minutes: G1 4.68 (SD 2.14), G2 2.97 (SD 1.15) p<0.001 24 hours: G1 6.08 (SD 1.87), G2 3.92 (SD 1.43) Adverse events: G1 4, G2 8 all transient and resolved appropriately.
Balakrishnamoorthy et al (2015, Australia) Double-blind Randomised Controlled Trial (RCT) (17)	N=58. Radicular low back pain. Female: n=28 Aged 18-55. Positive SLR test. Difficulty mobilizing.	Group 1(G1): 8mg IV dexamethasone. Standard care: regular analgesia, education, physiotherapy referral.	Group 2 (G2): 2ml IV 0.9% sodium chloride. Standard care: regular analgesia, education, physiotherapy referral.	24 hours: Pain VAS: 1.86 point greater reduction in group 1 (95% CI 0.3 to 3.4, p=0.02) EDLOS: Shorter in G1 (median 3.5 vs 18.8hrs, p=0.049) SLR ROM: G1: 14.7° greater improvement (95% CI 1.3 to 34.3, p=0.04) ODI: -3 mean diff (95% CI -15.1 to 9.1 p=0.62). * 6 weeks: Pain VAS: Significant improvement in pain both groups. G1: -4.28 (95% CI -6.2 to -2.54, p<0.001). G2: -2.83 (95% CI-4.37 to -1.28, p<0.001). * ODI: 2.9 mean diff (95% CI -13.4 to 19.3, p=0.72) * Ability to return to normal activities: 74% vs 60%, p=0.3. * Adverse events: G1: 18%. G2: 15%. All mild.
Behrbalk et al (2014, Israel) (18)	N= 59 Acute LBP Female: n=35 Age: 18-65	Group 1: 0.1mg/kg, up to 10mg IV morphine with 25mg	Group 2: 0.1mg/kg, up to 10mg IV morphine in 150ml normal saline solution over 30 minutes	2 hours: Pain VAS: G1 vs G2: 4mm less reduction in pain (95%CI -3 to 11) p=0.26 Anxiety VAS: G1 vs G2: 6mm less reduction in anxiety (95%CI -7 to 19) p=0.37

Single-blind RCT	No neurological deficit Baseline VAS≥70mm	promethazine, in 150ml normal saline solution over 30 minutes		EDLOS: G1 vs G2: 78mins increase (95%CI 16-140) p=0.01. Significant increase Gp1. Patient satisfaction VAS: G1 vs G2: 4mm less (95%CI -5 to 13) p=0.39. * Adverse events: G1 vs G2: 73.1% increase (50-85) p<0.001. Significantly more drowsiness and sedation in G1.
Eken et al (2014, Turkey) Double-blind RCT (19)	N=137 LBP (4-pt VRS: mod/sev). Acute (last week). Female: n=54. Age: 18-55. No neurological signs. No analgesia previous 6hr	<u>Group 1:</u> IV paracetamol 1g in 100ml saline solution. <u>Group 2:</u> IV morphine 0.1mg/kg in 100ml saline solution.	<u>Group 3</u> IV dexketoprofen 50mg in 100mg saline solution	<u>15 mins:</u> Pain VAS: G1 vs G2: 11.3 mean diff (95% CI 1 to 22). Gp2 vs Gp3: 15.3 mean diff (95%CI -25 to 6). G1 vs G3: 4 mean diff (95%CI -13 to 5). * <u>30 mins:</u> Pain VAS: G1 vs G2: 3.8 mean diff (95%CI -6 to 14). G1 vs G3 7.4 mean diff (95%CI -18 to 3). G2 vs G3: 11.2 mean diff (95%CI 2 to 21). * Rescue analgesia: Group 1: 17.4%, group 2: 4.4%, group 3: 15.2%. P=0.135. * Adverse effects: Group 1: 8.7%, group 2: 15.5%, group 3: 8.7%. P=0.482. *
Ergün et al (2010, Turkey) Double-blind RCT (15)	Short-term: n=72. Long-term: n=61. LBP Short term: female: n=45 Long-term: female: n=39 Age: 18-55 Normal blood markers No muscle relaxant or NSAID use in past 12 hrs	<u>Group 1:</u> Acute: Oral 2 x 400mg sugarcoated phenyramidol tablets. Chronic: Oral400mg phenyramidol. TTD 3, 7 days Rescue: Oral 20 x 275mg naproxen sodium TTD max 4.	<u>Group 2:</u> Acute phase: Intramuscular 800mg phenyramidol ampoule. Chronic phase: Placebo. Rescue analgesia: Oral 2 x 275mg naproxen sodium TTD max 4	<u>Acute phase 2hrs:</u> Pain VAS: Pain reduction between groups p=0.624. * Pharmacokinetic parameters: * Adverse effects: 11% of patients in each group suffered mild/mod. <u>Chronic phase 1 week:</u> Rescue analgesics: Less than 1 per day. * Median global evaluation score: “Mildly effective” patients and physicians both gps. Adverse effects: 7/38 patients in group 2 showed elevated liver enzymes, resolving with no treatment 7 days later.
Eskin et al (2014, USA) Double-blind RTC	N=79 24hr history of LBP Female: n=24 Age: 18 to 55 Pain >5 VAS	<u>Group 1:</u> Oral 50mg prednisone, and 4 x 50mg oral prednisone to	<u>Group 2:</u> Oral placebo tablet, and 4 placebo tablets to take home, to use one per day.	<u>5-7 days:</u> 3-point pain VRS: G1 vsG2: 0.2 mean diff (95%CI -0.2 to 0.6) p=0.25. * Further medical care: G1 vs G2: 22% mean diff (95%CI 0 to 43%) p=0.05. Significantly more patients in the prednisolone group sought further medical care than in the placebo group.

(37)	No neurological motor deficits. No current use of steroids	take home, to use one per day. Analgesic therapy in ED: physician's judgement, not corticosteroids.	Analgesic therapy in ED: physician's judgement, not corticosteroids	Days lost to work: G1 vs G2: 0.9 mean diff (95%CI -0.1 to 1.8) p=0.06. * Resumed normal activities: G1 vs G2: 0%mean diff (95%CI -23 to 23) p=1 * Returned to work: G1 vs G2: -1%mean diff (95%CI -22 to 19) p=0.95 * Patient satisfaction: G1 vs G2: 0.0%mean diff (95%CI -0.2 to 0.3) p=0.90 * Adverse effects: None reported in either group.
Friedman et al (2006, USA) Double blind RCT (25)	N=87 Non radicular LBP <7 day History Female: 51 Age: 21 to 50 No corticosteroid use	<u>Group 1:</u> IM 160mg methylprednisolone acetate. Standard care: as above.	<u>Group 2:</u> IM 160mg placebo. Standard care: as above	<u>1 week:</u> Past 24-hour pain NRS: 0.6 mean difference between groups (95%CI -0.9 to 2.2) * RMDQ-18=0: G1 71% vs G2 74% Return to usual activities: G1 87% vs G2 79%. * Adverse effects: 24% diff btwn Gps (95% CI, 16 to 35). Worse in G1. % pain free patients: G1 33 vs G2 40%. * <u>1 month:</u> Pain NRS: 0.6 mean diff(95%CI -1 to 2.2) * RMDQ-18=0: G1 77% vs G2 74%. * Return to usual activities: G1 85% vs G2 80%. * %pain free: G1 55% vs G2 57%. *
Friedman et al (2008, USA) Double-blind RCT (20)	N=82 Non-recurrent radicular LBP <7 day history Female: n=43 Age: 21 to 50 Positive SLR (30-70°) No corticosteroid use	<u>Group 1:</u> IM 160mg methyl-prednisolone acetate. Standard care: 14 x 500mg naproxen twice daily, 14 x oxycodone 5mg/acetaminophen as needed, LBP instruction sheet.	<u>Group 2:</u> IM 160mg placebo. Standard care: 14 x 500mg naproxen twice daily, 14 x oxycodone 5mg/acetaminophen as needed, LBP instruction sheet	<u>1 week</u>: Past 24-hour pain NRS: G1 vs G2: 1.1 mean reduction (95%CI -0.5 to 2.8) p=0.16.* Disability self report: G1 vs G2: 19% reduction (95%CI -4 to 42) Adverse effects: Gp1 vs Gp2: 32% vs 24%, (95%CI for diff 9%, -12 to 30) <u>1 month:</u> Past 24-hour pain NRS: G1 vsG2: 1.3 mean reduction (95%CI -0.2 to 2.7) p=0.10. * Disability self report: G1 vs G2: 29% reduction (95%CI 9 to 49) p=0.007. Significant difference between groups. Analgesic use 24 hours: G1 vs G2: 20% reduction (95%CI 0 to 40) p=0.06 Not yet resumed usual activities: G1 vs G2: 9% reduction (95%CI -9 to 27) p=0.34 *

Friedman et al (2015, USA) Single-blind RCT (23)	N=323 Acute musculoskeletal LBP Non-traumatic Non-radicular Female: n=158 Age: 21 to 64 RMDQ score >5	<u>Group1:</u> Oral 60 x 5mg cyclobenzaprine tablets, 1 or 2 tablets every 8 hours, as needed. <u>Group2</u>: Oral 60 x 325mg oxycodone 5mg/ acetaminophen tablets, 1 or 2 tablets every 8 hours, as needed. Both groups: Oral 20 x 500mg naproxen tablets, 1 every 12 hours	<u>Group3:</u> Oral 60 x placebo tablets, 1 or 2 tablets every 8 hours, as needed. Oral 20 x 500mg naproxen tablets, 1 every 12 hours.	<u>7 days:</u> RMDQ: G1 vs G3=0.3(98.3% CI -2.6-3.2) p=0.77. G2 vs G3=1.3 (98.3% -1.5 to 4.1) p=0.28. G1 vs G2=0.9 (98.3% CI -2.1 to 3.9) p=0.45. * No. day usual activity: G1=4, G2=4, G3=5. No. days return to work: G1=3, G2=2, G3=3. Worse LBP 24hrs mod/sev: G1=43%, G2=38%, G3= 49%. Frequency LBP (frequently/always): G1=31%, G2=30%, G3=37%. Use of medication: G1=62%, G2=59%, G3=68%. Adverse effects: G1 vs G3: 19% more adverse events (95%CI 7 to 31). G2 vs G3: 13% more adverse events (95%CI 1 to 25). <u>3 months:</u> RMDQ: G1 vs G3= 0.6 (-1.3 to 2.6), G2 vs G3= 0.8(-1.1 to 2.7), G1 vs G2=0.2(-1.9 to 2.2) mean % diff (CI 95%). Worse LBP 72hrs % (mod/sev): G1=27, G2=21, G3=28. Frequency LBP 72hrs %(freq/always): G1=12, G2=18, G3=19. Use of meds %: G1=26, G2=20, G3=28. Use of medication 72hrs: G1 vs G3: reduction of 2(95%CI-10 to 14) G2 vs G3: reduction of 8(95%CI -3 to 19)
Friedman, B. et al (2017, USA) Randomised, double blind, comparative efficacy trial. (24)	N=114 Age: 21 to 69 (mean=36). Non-traumatic, non-radicular, musculoskeletal LBP. RMDQ>5. Pain <2 weeks.	<u>Group 1:</u> Naproxen 500mg tablets taken twice per day. Diazepam 5mg taken as 1 or 2 tablets every 12 hours for 7 days.	<u>Group 2:</u> Naproxen 500mg tablets taken twice per day. Placebo taken as 1 or 2 tablets every 12 hours for 7 days.	<u>1 week:</u> RMDQ: Mean improvement: G1 11(95%CI 9 to 13) vs G2 11 (95%CI 8 to 13). * Median days return to usual activity: Diff between groups: -0.4 (95%CI -0.6 to 1.4) * Worst LBP 24hrs: 4 item ordinal scale. Diff between groups: -10 (95%CI -26 to 7) * Frequency of LBP 24hrs: 3 item ordinal scale. Diff between groups: -6 (95%CI -25 to 12) * Use of medication: Diff between groups: 0 (95%CI -19 to 18) * Adverse events: Diff between groups: 6 (95%CI -9 to 20) * No serious or unexpected adverse events. <u>3 months:</u> RMDQ: Median score G1: 0, G2: 0. Diff between groups: -2 (95%CI -4.2 to 0.3)* Worse LBP 72hrs: Diff between groups: -3 (95%CI -15 to 9) * Frequency LBP 72hrs: Diff between groups: 5 (95%CI -10 to 20) * Use of medication 72hrs: Diff between groups: -5 (95%CI -18 to 9) *

Friedman, B. W. et al (2018, USA) Randomised, double blind, comparative effectiveness trial. (26)	N=240 Age: 18 to 69 (mean 39) Non-traumatic, non-radicular, musculoskeletal LBP RMDQ >5 Pain duration <2 weeks	<u>Group 1:</u> Naproxen 500mg twice per day. Orphenadrine 100mg twice per day. <u>Group 2:</u> Naproxen 500mg twice per day. Methocarbamol 750mg as 1 or 2 tablets 3 times per day.	<u>Group 3:</u> Naproxen 500mg twice per day. Placebo randomised to match the dosing patterns of group 1 and group 2.	<u>1 week:</u> RMDQ: Mean improvement: G1: 9.4 (95%CI 7.4 to 11.5), G2: 8.1 (95% CI 6.1 to 10.1), G3: 10.9 (95% CI 8.9 to 12.9. * Mean diff: G1 vs G3 1.5 (95%CI -1.4 to 4.3), G2 vs G3 2.8 (95%CI 0 to 5.7). Median days until usual activities: Differences: G1 vs G3: 0.2 (95%CI -0.7 to 1.0), G2 vs G3: 0.3 (95%CI -0.6 to 1.1), G1 vs G2: 0.1 (95%CI -0.8 to 1.0). * Worst LBP 24Hrs (%): Differences: G1 vs G3: 1 (95% CI -14 to 16), G2 vs G3: 5 (95% CI -11 to 20), G1 vs G2: 5 (95% CI -10 to 20). * Frequency of LBP 24hrs (%): Differences: G1 vs G3: 4 (95%CI -12 to 20), G2 vs G3: 7 (95%CI -8 to 23), G1 vs G2: 11 (95%CI -4 to 27). * Use of medication 24hrs (%): Differences: G1 vs G3: 4 (95%CI -12 to 20), G2 vs G3: 7 (95%CI -8 to 23), G1 vs G2: 11 (95%CI -4 to 27). * More than 80% of participants did not visit health care providers. Adverse events: G1: 7%, G2: 14%, G3: 13%. <u>3 months:</u> RMDQ (median): G1: 0 (IQR 0 to 4), G2: 0 (IQR 0 to 13), G3: 0 (IQR 0 to 8).*. Worst LBP 72hrs (% mild/none): G1: 55, G2: 58, G3: 55. *
Friedman, B. W. et al (2019, USA) Double blind RCT (35)	N=320 Mean age: (39) Non-traumatic, non-radicular, musculoskeletal LBP RMDQ >5 Pain duration <2 weeks	<u>Group 2 (n=80):</u> 600mg ibuprofen plus 10-20mg baclofen orally 8 hourly. <u>Group 3 (n=80):</u> 600mg ibuprofen plus 400-800mg metaxalone orally 8 hourly. <u>Group 4 (n=80):</u> 600mg ibuprofen plus tizanidine 2-4 mg orally 8 hourly.	<u>Group 1 (n=80):</u> 600mg ibuprofen plus placebo orally 8 hourly.	<u>48 hours:</u> % severe LBP: G1 62%, G2 48%, G3 55%, G4 47%. % frequent LBP: G1 38%, G2 30%, G3 36%, G4 31%. Medication use: G1 94%, G2 91%, G3 91%, G4 90%. Resumed usual activities: G1 47%, G2 51%, G3 41%, G4 46% <u>1 week:</u> Mean improvement RMDQ: G1 11.1 (95%CI 9.0-13.3), G2 10.6 (95%CI 8.6-12.7), G3 10.1 (95%CI 8.0-12.3), G4 11.2 (95%CI 9.2-13.2). % severe LBP: G1 30, G2 33, G3 37, G4 33. % frequent LBP: G1 16, G2 27, G3 32, G4 24. Medication use: G1 63, G2 62, G3 64, G4 63. Median days until usual activities: G1 2(IQR 2-7), G2 4(IQR 2->7), G3 3(IQR 2-7), G4 3(IQR 2-7). % Adverse events: G1 7, G2 10, G3 9, G4 8.

Friedman, B.W. et al (2020, USA) Double blind RCT (34)	N=120 Mean age: 41 Non-traumatic, non-radicular, musculoskeletal LBP RMDQ >5 Pain duration <2 weeks	Group 1: (n=60) 600mg ibuprofen plus 500-1000mg acetaminophen orally 6 hourly.	Group 2: (n=60) 600mg ibuprofen plus placebo orally 6 hourly.	48 hours: RMDQ improvement: btwn G difference 0.1 (95%CI -3.4 to 3.5) % mild LBP: btwn G difference 3 (95%CI -15 to 21) % rare vs frequent LBP: btwn G difference 2 (95%CI -15 to 19) % no use of medication: btwn G difference 7 (95%CI 7 to 21) 1 week: Median RMDQ: G1 10 (IQR 0 to 20), G2 12 (IQR 0 to 18) %mild LBP: Btwn G difference 0 (95%CI -17 to 17). % rare vs frequent LBP: btwn G difference 1 (95%CI -18 to 19) % no use of medication: btwn G difference 2 (95%CI -11 to 20) Median days until usual activities: btwn G difference 0.6 (IQR -0.5 to 1.7) No visit to health care provider %: btwn G difference 7 (95%CI -4 to 17)
Guillen-Astete, C. A. et al (2017, Spain) Retrospective observational study. (43)	N=732 Back pain Group 1: significantly younger, less men, more comorbidities, significantly higher VAS and significantly lower SF-36.	Group 1 (n=91): Tapentadol. 23 received 25mg twice daily and 68 received 50mg twice daily. 15.4%(14) also received NSAID	Group 2 (n=641): No tapentadol. 414 received tramadol: 44 TDD ≤37.5mg/d. 141 TDD >37.5, ≤100mg. 172 TDD >100mg, ≤200mg. 57 TDD >200mg. 67.2%. 431 also received NSAID	7 days: Pain VAS: G1: superior clinical evolution of pain (VAS and SF-36) than G2. P<0.0001. In G2 patients who received tramadol had a better clinical evolution of pain vs no tramadol or tapentadol: p=0.007. 1 month: Reassessment: G1: 20.9% vs G2: 50.3%. P<0.0001 (OR 0.258, 95%CI 0.147 to 0.453). Significant reduction in reassessment in G1. Adverse effects G1: 3(3%) patients attended for adverse effects. G2: 3 (5%) patients attended for adverse effects. *
Innes et al (1998, Canada) Double-blind RCT (39)	N=122 Moderate LBP (5-point verbal rating scale) Female: n=26 Age: 18 to 60 Weighing >50kg Discharged within 2 to 4 hours Requiring oral analgesics	Group 1: Oral 10mg ketorolac tromethamine, then the same every 4 to 6 hours as needed, up to 4 daily doses. Rescue analgesia: oral 650mg acetaminophen.	Group 2: Oral 600mg acetaminophen/ 60mg codeine, then the same every 4 to 6 hours as needed, up to 6 daily doses.	6 Hours: Pain VAS: Peak pain intensity difference in both groups was 2.2hrs. G1 -25.5 (SD 17.9) G2 -27.7 (SD 17.9) no difference between groups. 1 week: Pain VRS: Day 4: “a lot” or “complete” achieved by G1 53% (95%CI 40 to 66) and G2 55% (95%CI 42 to 68). No significant difference between groups at one week. Functional capacity: Both groups improved, no difference between groups (74% (62-86) vs 73% (61-74) reported “moderately” or “severely impaired” on day 1; 67% (55-79) vs 62% (50-74) on day 4 reported “No” or “mild impairment”. 1 month:

				Overall drug rating: No significant difference between groups G1: 48% vs G2: 45% "very good" or "excellent. G1: 29% vs G2: 18% good, 23% vs 37% "fair" or "poor". Adverse effect: G2 2: 34% (95%CI 22-46) vs G1 64% (95%CI 52-76) p=0.0005.
Kocak, A. O. et al (2019, Turkey) Non-blinded Randomised study (30)	N=54 Mean age: 43 <48 hour onset non radicular LBP Presence of at least 1 trigger point	Group 1: Small amounts of local anesthetic (2% lidocaine, 2.5 cc from 100 mg-5 cc of ampoule with 2.5 cc saline) injected into trigger points	Group 2: 50 mg dexketoprofen in 100cc isoltonis solution over 5 minutes.	Mean pain VAS: 5 minutes: G1 2.77 (SD 2.81), G2 6.22 (SD 2.11) p<0.0001 10 minutes: G1 1.45 (SD 2.15), G2 5.22 (SD 2.41) p<0.0001 15 minutes: G1 0.82 (SD 1.71), G2 4.25 (SD 2.41) p<0.0001 30minutes: G10.55 (SD 1.6), G2 3.28 (SD 2.44) p<0.0001 60 minutes: G1 0.41 (SD 1.3), G2 2.59 (SD 2.37) p<0.0001 Respond to treatment (yes/no) G1 21/1, G2 20/12 p=0.008 No adverse events.
Miller et. al. (2015, USA) Retrospective cohort comparison (36)	N=63 Severe LBP (axial +/- radiculopathy) Spondylosis Refractory to NSAIDs, muscle relaxants and IV narcotics treatment Female: n=31 Average age of 48 years	Group 1: After maximal attempts for pain relief in the ED failed, one Image-guided inter laminar epidural steroid injection. Hospital admission for pain relief.	Group 2: After maximal attempts for pain relief in the ED failed. Hospital admission for pain relief.	2 weeks: Cost of care: G1 $4,800 (SD 2000) vs G2 $33,000 (SD 14000) p<0.001. Significantly lower in G1. EDLOS: G1 8hrs (SD 3.6) vs G2 13hrs (SD4.2) p<0.002. Significantly less in G1. Medication use: G1: 1/4 of hydromorphone dose and 1/3 of morphine dose while in ED, p<0.0001; 1/10 of hydromorphone dose and 1/18 of oxycodone dose prescribed, p<0.0001. Consultant utilisation: G1 3 vs G2 18 times, p<0.0001. Admission time: G1 mean 0 days vs G2 mean 5 days, p<0.002.
Serinken, M. et al (2016, Turkey) Double-blind RCT (21)	N=300 Age: 21 to 65 (mean=42.9) Sciatica and positive SLR 49.3% male Pain: <1 week, VAS>40mm.	Group 1: IV morphine (0.1mg/kg) in 100mls saline. Group 2: IV paracetamol (1g) in 100mls saline.	Group 3: 100mls normal saline. Fentanyl 1ug/kg rescue drug at 30mins if needed.	30mins: Pain VAS: Median changes: G1 54mm (95% CI=50-60mm), G2 29mm (95% CI=28-34mm), G3 12.5mm (95% CI 10-15). Median changes between groups: G1 vs G2 25mm (95% CI=20-29mm), G1 vs G3 41mm (95% CI=37-45mm), G2 vs G3 16mm (95% CI=12-2-mm). Rescue fentanyl: G1 6% (95%CI=2-13.2), G2 18% (95% CI 10.7-28.5), G3 80% (95% CI 63-99). Adverse effects: G1: 4 G2: 3 G3: 0

		Fentanyl 1ug/kg rescue drug at 30mins if needed.		
Serinken, M. Eken, C. et al (2016, Turkey) Double-blind RCT (27)	N=140 Age: 18 to 65 (35+/-12) 56% male Mechanical LBP (no sciatica) Pain <24hrs. VAS >40mm.	<u>Group 1:</u> 50mg IV dexketoprofen. 2g of 2.5% ketoprofen gel over approx 5cm diameter.	<u>Group 2:</u> 50mg IV dexketoprofen. 2g of placebo gel over approx 5cm diameter.	<u>15 mins:</u> Pain VAS: G1: mean reduction 27 (SD 13), G2: mean reduction 28 (SD13) Mean diff: 0.5 (95%CI -4 to 5) p=0.8 <u>30mins:</u> Pain VAS: G1: mean reduction, G2: mean reduction. Mean diff: 16 (95%CI 10-21) p=0.000. Significant improvement in G1. Rescue drug: G1 3%, G2 14%. Adverse events: 1 patient per group.
Tanen et al (2014, USA) Double-blind RCT (28)	N=44 Acute radicular LBP Female: n=19 Age: 15 to 55 Pain >25mm VAS	<u>Group 1:</u> IV 100mg lidocaine over 2 minutes, followed by 10cc normal saline flush	<u>Group 2:</u> IV 30mg ketorolac over 2 minutes, followed by 10cc normal saline flush	<u>60 mins:</u> Pain VAS: G1: median reduction 8 (95%CI 0 to 23) p=0.003. G2: median reduction 14 (95%CI 0 to 28) p=0.007. P=0.835. * Clinical significance accepted by study: 13mm reduction in VAS. Rescue medication: G1 vs G2: 67% vs 50% p=0.35. * <u>1 week:</u> Pain Relief Scale 0-5: G1 vs G2: median differences 0 vs 0, p=0.388. *
Veenema et al (2000, USA) Double-blind RCT (16)	N=155 LBP Female: n=60 Warrants parenteral Age: over 18 Pain VAS >70mm	<u>Group 1:</u> IM 1mg/kg meperidine	<u>Group 2:</u> IM 60mg ketorolac	<u>60 mins:</u> Pain VAS: Ketorolac 7mm (36 vs 29) less Pain Intensity Decrease than meperidine; 95% CI -15 to 2.6). Significant pain reduction in both groups. * Rescue analgesia: 37% vs 35%, (OR 0.47-1.74 95% CI) * Sedation: Sedation level by 3-point ordinal scale, adverse effects, rescue analgesia, 5-point patient satisfaction scale. Satisfaction: 74% vs 68%. * Adverse effects: G1 (41/75) vs G2 (8/80) 95%CI .27 to .63. More sedation in G1 (71% vs 24% “sedated” or “asleep, OR 3.54-17.4

Key: SD= Standard Deviation, CI= Confidence Interval, Mg= Milligrams, VRS= Visual Rating Scale, NRS= Numerical Rating Scale, G= Group, OR= Odds Ratio, ED= Emergency Department, IV= Intravenous, IM=Intramuscular, LBP= Low back Pain, *No significant difference between groups, ICD= International Classification of Disease Revision Codes, EDLOS= Emergency department length of stay, ODI= Oswestry disability index, NSAID= Non-steroidal anti-inflammatory, TDD= total daily dose, SLR ROM=straight leg raise range of movement, VAS=visual analogue scale, RMDQ= Roland Morris Disability Index

Table 2: Non-pharmacological interventions PICOS

Authors, publication year, Country	Participants	Interventions	Comparisons	Outcomes
Cohen, M.M. et al (2017, Australia) Pragmatic, multicentre, single blinded, RCT (32)	N= 528 (270 51% with LBP) Age: mean 41 years 47% female Pain VNRS >4	<u>Group 1:</u> Acupuncture alone: predetermined treatment protocol, plus additional points. <u>Group 2:</u> Combined treatment: acupuncture and pharmacotherapy, 15 minutes apart to maintain blinding.	<u>Group 3:</u> Pharmacotherapy alone: standardised protocol based. Back pain: diazepam, Hartmann's solution, paracetamol, paracetamol/codeine, tramadol, dextropropoxyphene and paracetamol, NSAID, IV morphine.	<u>1 hour</u> Pain NRS: Mean decrease: G1 1.9 (SD 2.3) G2 2.2 (SD2.2) G3 2.0 (SD2.3)* p=0.29. Rescue analgesia: G1 45 (25%) G2 27 (15%) G3 26 (15%) Significantly more use in G1 p=0.016. Satisfaction: * p=0.91 EDLOS: G1 3.8(IQR 2.9 to 4.9) G2 3.7(IQR 2.8 to 4.8), G3 3.9(IQR2.7 to 5.3).* p=0.87 <u>48 hours</u> Admission rate: G1 27(19%) G2 13(9.2%) G3 20(15%). Significantly more admissions in G1 p=0.07 ODI mean difference: G1 27.9 (12.7), G2 27.4 (11.5), G3 29.3 (11.1)* p=0.52. No statistically significant change in any other outcome measure after 1 or 48 hours.
Fox, L. M. et al (2018, USA) RCT: pilot study to examine feasibility and efficacy. (14)	N=30 Age: >18 years (mean 41) 56% female Acute or acute on chronic LBP	<u>Group 1:</u> Standard care (discretion of treating physician) Battlefield acupuncture. Protocol: indwelling semi-permanent needles	<u>Group 2:</u> Standard care (discretion of treating physician)	<u>Post intervention</u> Time to get up and go test: G1 21.3 (95% CI 18.2-24.5) G2 19 (95% CI 15.6-22.5) *p=0.33. LBP NRS: G1 5.2 (95% CI 4.2-6.2, G2 6.9 (95% CI 5.7-8.3). G1 significantly lower p=0.04. Leg pain NRS: G1 1.4 (95%CI 0.1 to 2.7) G2 2.2 (95%CI 0.7 to 3.5)* p=0.43 *flexion, extension EDLOS, medication and adverse events were not reported.
Lau et al (2008, Hong Kong) Single blind RCT	N=110 Acute low back pain +/- leg referral Female: n=67	<u>Group 1:</u> Stay active advice, return early to normal activities, educational session,	<u>Group 2:</u> Conventional intervention: walking training, walking aids as indicated.	<u>Discharge from ED:</u> Pain NRS: Between group diff: -1.6(97.5%CI -2.3 to 0.8) Significantly less pain in group 1. RMDQ: Between group diff -0.3 (-2.8 to 2.2) BPS: Between group diff: -0.6(97.5%CI-1.7 to 0.6)

(22)	Age: 19-88 (mean 50) No previous episode of acute low back pain in the previous 6 months	mobility training, walking, 1 or 2 interferential therapy session. Standard medical pain management. Standard outpatient physiotherapy after discharge.	Standard medical pain management. Standard outpatient physiotherapy after discharge.	Patient satisfaction: Between group diff 2.1 (97.5%CI 1.2 to 2.9) SF-12P: between group diff -2 (-6 to 2) SF-12M: between group diff 5 (0.3 to 9) <u>1 month:</u> Pain NRS: Between group diff -0.4 (-0.3 to 0.5) RMDQ: Between group diff -0.6 (-1.7 to 0.6) Satisfaction:* SF-12P: Between group diff -1 (-0.5 to 2) SF-12M : Between group diff 1 (-4 to 5) <u>6 months</u> *all outcome measures
Liu et al (2015, Taiwan) Pilot cohort study (31)	N=59 Acute LBP Female: n=30 ICD-9 724.2 Lumbago Age: 20 to 90	<u>Group 1:</u> Fixed point acupuncture set protocol. Needles stimulated until "De Qi" and stayed in place for 15 minutes.	<u>Group 2:</u> Fixed point sham acupuncture by pasting seed patches next to the set protocol points.	<u>After intervention:</u> Pain VAS. Median reduction: G1: 3 p<0.001, G2: 1 p=0.109. Significant difference between groups: p<0.001 Heart rate variability. * Adverse effects. None reported. <u>3 days:</u> Pain VAS. Median reduction: G1: 4 p<0.001, G2: 2.5 p=0.011.* p=0.181
Sayer, J.M. et al (2018, Australia) Retrospective audit	N=1565 Age: 18-65 years (42) 50% female LBP: ICD-10 M543, M545, M5499, S337, S390	<u>Group1:</u> Seen by AMPs who had undertaken a competency based training and assessment program.	<u>Group 2:</u> Seen by non-AMP clinician (ED doctors and nurse practitioners)	<u>1 week</u> EDLOS: G1 141 mins G2 175min. Significantly less in G1 (p<0.001). Admissions rate: G1 36 G2 258. Significantly less in G1 (p<0.001). <u>Audit period</u> Re-present: * 24hrs, 48hrs, 1 week, 1 year (p=0.26)

Key: G= Group, ED= Emergency Department, IV= Intravenous, IM=Intramuscular, LBP= Low back Pain, *No significant difference between groups, ICD= International Classification of Disease Revision Codes, EDLOS= Emergency department length of stay, ODI= Oswestry disability index, NSAID= Non-steroidal anti-inflammatory, TDD= total daily dose, SLR ROM=straight leg raise range of movement, VAS=visual analogue scale, NRS=numerical rating scale, RMDQ= Roland Morris Disability Index, AMP= Advanced Musculoskeletal Physiotherapists, BPS= Back Performance Scale, RCT= Randomised Control Trial.

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232 **Table 3: Downs and Black scores of pharmacological studies.**

Author(s) (Publication year)	Reporting (11)	External Validity (3)	Internal validity (7)	Selection bias (6)	Power (5)	Total score	Quality
Balakrishnamoorthy et al (2015) (17)	10	3	7	6	5	31	Excellent
Friedman et al (2006) (25)	10	3	7	6	5	31	Excellent
Friedman et al (2019) (35)	10	3	7	6	5	31	Excellent
Friedman et al (2015) (44)	11	3	6	5	5	30	Excellent
Friedman, Irizarry et al (2017) (24)	10	3	6	6	5	30	Excellent
Friedman et al (2020) (34)	10	2	7	6	5	30	Excellent
Serinken, Eken et al (2016) (27)	9	3	7	6	5	30	Excellent
Friedman, Ciewski et al (2018) (26)	10	3	5	5	5	28	Excellent
Akbas et al (2019) (29)	10	3	4	6	5	28	Excellent
Eken et al (2014) (19)	10	3	5	6	3	27	Excellent
Serinken et al (2016) (21)	9	2	6	5	5	27	Excellent
Guillen-Asete et al (2017) (43)	10	3	4	4	5	26	Good
Eskin et al (2014) (37)	10	2	5	5	3	25	Good
Behrbalk et al (2014) (18)	9	1	6	3	5	24	Good
Ergün et al (2010) (15)	9	3	6	2	3	23	Good
Innes et al (1998) (39)	11	1	6	5	0	23	Good
Friedman et al (2008) (20)	10	3	6	3	0	22	Good
Kocak et al (2019) (30)	10	2	5	4	0	21	Good
Tannen et al (2014) (28)	9	1	7	4	0	21	Good
Veenema et al (2000) (16)	9	1	7	4	0	21	Good
Miller et. al. (2015) (36)	9	1	4	2	0	16	Fair

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236 **Table 4: Downs and Black scores of non-pharmacological studies.**

Author(s) (Publication year)	Reporting (11)	External Validity (3)	Internal validity(7)	Selection bias (6)	Power (5)	Total score	Quality
Cohen et al (2017) (32)	9	3	6	5	5	28	Excellent
Sayer et al (2018) (	10	3	5	4	0	22	Good
Lau et al (2008) (33)	8	3	4	5	0	20	Fair
Liu et al (2015) (31)	10	1	6	3	0	20	Fair
Fox et al (2018) (14)	9	1	5	3	0	18	High

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238 **Table 5: Grouped positive and negative finding of pharmacological studies**

Intervention	**Positive Findings** (context)[quality score of study]	**Negative findings** (context)[quality score of study]
Corticosteriods	IV dexamethasone: Reduced pain after 24 hours (-1.86 VAS compared to SC, radicular patients)[excellent] Reduced EDLOS (-15.3 hours compared to SC, radicular patients)[excellent](17)	IM methylprednisolone: Not superior to SC (patients with no neurological deficit) [excellent](25)
	IM methylprednisolone: Lower disability (-29% compared to SC, radicular patients)[good] Less analgesic use (-20% from SC, radicular patients)[good](20)	Oral prednisolone: More healthcare utilization (+22% compared to SC, patients with no neurological deficit)[good] More days lost from work (+0.9 days compared to SC, patients with no neurological deficit)[good](37)
	Epidural steroid: Lower healthcare cost, less medication and consultation utilized (Cost at $4,800, compared to $33,000 of SC, spondylosis patients after maximal pain reduction attempts failed)[fair](36)	
NSAIDs	Naproxen: As effective alone than combined with acetaminophen-codeine, or cyclobenzaprine (both short and long-term, no neurological deficit) [excellent](23) As effective alone than combined with Diazepan (non-radicular LBP)[excellent] As effective alone than combined with orphenadrine or methacarbamol (non-radicular LBP)[excellent](26)	IV dexketoprofen: Not superior to IV paracetamol or IV morphine (patients with no neurological deficit)[excellent](19)
	ketoprofen gel: 2g of 2.5% plus 50mg IV dexketoprofen superior to placebo plus 50mg IV	

	dexketoprofen (non-radicular LBP)[excellent](27)	
	IV Ketorolac: As effective as IV lidocaine, less need for rescue analgesia (radicular patients)[good](28)	
	IM Ketorolac: As effective as IM meperidine, better adverse effect profile (71% vs 24% of patients sedated or asleep) [good](16)	
	Oral Ibuprofen: As effective alone than combined with oral Baclofen, Metaxolone or Tizanidine (non-radicular LBP) [excellent] (35) As effective alone than combined with oral paracetamol (non-radicular LBP)[excellent] (34)	
Muscle relaxants		Cyclobenzaprine: Not superior to Naproxen alone (no neurological deficit)[excellent](23)
		Diazepam: Not superior to Naproxen alone (non-radicular LBP)[excellent](24)
		Methocarbamol: Not superior to naproxen alone (non-radicular LBP)[excellent](26)
		Phenyramidol: Not superior to placebo [good] (15)
		Baclofen, Metaxolone and Tizanidine: Not superior to placebo when combined with ibuprofen (non-radicular LBP)[excellent] (35)
Paracetamol	IV paracetamol: as effective as IV dexketoprofen and IV morphine (patients with no neurological deficit)[excellent](19)	IV paracetamol: Inferior to IV morphine, same adverse effect profile (radicular LBP)[excellent](21)
Opioids	IV morphine: Superior to IV paracetamol, same adverse effect profile (radicular LBP)[excellent](21)	Acetaminophen-codeine: Combined with Naproxen is not superior to Naproxen alone (short and long term, no neurological deficit)[excellent](23) Not superior to oral ketorolac (combined with acetaminophen), worse adverse effect profile (64% vs 34% of patients experienced adverse effects)[good]
	Tapentadol: Superior to other medications used in the ED, less need for reassessments (back pain)[good] (43)	IV morphine: Not superior to IV paracetamol or IV dexketoprofen (patients with no neurological deficit)[excellent](19)
Antihistamine (anxiolytic-sedative)		Promethazine: When combined with morphine, not superior to morphine alone in pain control, worse adverse effect profile (50% to 85% more sedation and

		drowsiness,) higher EDLOS (+78 minutes) [good](18)
Trigger point injections	Mesotherapy (thiocolchicoside, lidocaine, tenoxicam) of minimum 50 injections: Superior to IV dexketoprofen (radicular LBP)[excellent] (29)	
	Lidocaine: Superior to IV dexketoprofen (non-radicular LBP) [Good] (30)	

Key: IV Intravenous, SC Standard care, LBP low back pain, EDLOS Emergency department length of stay, IM intramuscular, VAS Visual Analogue Scale, ED Emergency Department, Mg Milligrams

Table 6: Grouped positive and negative finding of non-pharmacological studies

Intervention	**Positive findings (context) [Quality score of study]**	**Negative findings (context) [Quality score of study]**
Physiotherapy	Physiotherapy assessment: Superior to Doctor or nurse assessment, significantly less EDLOS and admissions (back pain +/- sciatica)[good]	Physiotherapy intervention: Not superior at 6 month follow up. (back pain +/- radiculopathy)[fair]
	Physiotherapy intervention: Superior to SC for pain relief and function on discharge and 1 month follow up (back pain +/- radiculopathy)[fair]	
Acupuncture	More pain reduction than sham acupuncture post-treatment (2cm vs 0cm for sham acupuncture) no adverse effects [fair]	Not superior to acupuncture combined with SC pharmacotherapy and pharmacotherapy alone and has worse admission rates and need for rescue analgesia (LBP)[excellent]
	Significant reduction in pain post-treatment (mean 2.18, battlefield acupuncture, back pain) [fair]	No difference in pain at 3 days [fair]
		No significant difference in functional outcomes (battlefield, back pain) [fair]

Key: SC Standard care, EDLOS Emergency Department, LBP Low Back Pain,

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