INTRODUCTION

Chronic lumbar radicular pain or sciatica may be due to a multitude of reasons including disc herniation, spinal stenosis, and post-lumbar surgery syndrome [1]. There has been extensive literature since the initial description of disc herniation by Mixter and Barr in 1934 [2]. Symptomatic herniated lumbar disc was shown to be present in 1% to 3% [3], whereas the highest prevalence was among people aged 30 to 50 years [4]. Further, herniated discs occurred

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most commonly at the lower lumbar spine (L4/5 and L5/S1 levels) and also among those aged 25 to 55 years [5,6].

The mechanism of radicular pain in disc herniation may relate to mechanical compression or inflammation [1,7-10]. While surgical interventions are considered the mainstay of treatment for lumbar disc herniation or radiculopathy [11], multiple studies have shown epidural injections to be effective [1,10].

Epidurals with local anesthetics, with or without steroids, performed under fluoroscopic guidance, have been shown to be effective in managing disc herniation and radiculitis in multiple studies with level I evidence [1,10]. However, the failure of epidural injections may range from 30% to 50% of patients on a long-term basis. In such cases, percutaneous neurolysis may be employed in the nonsurgical management of chronic lumbar radicular pain [1,12].

Percutaneous neurolysis has been described to treat post-lumbar surgery syndrome and central spinal stenosis; however, systematic evaluations of effectiveness are lacking with disc herniation and chronic radicular pain [1,12-17]. Percutaneous neurolysis, epidural lysis, or lysis of epidural adhesions has been utilized for the past 30 years [1,12-17]. Epidural neurolysis is based on several premises, including that epidural fibrosis may present with low back pain and/or radicular pain, not only in post-surgical syndromes and spinal stenosis, but also disc displacements with leakage of disc materials. These adhesions can cause pain by immobilizing the nerve roots and also prevent injected materials from reaching the intended targets in the epidural space. As a result, pain relief can be achieved by removing these adhesions with the adhesiolysis (neurolysis) procedure that facilitates therapeutic medications reaching the target site and restores the normal movement of the nerve roots [1,12-16,18-25]. McCarron [20] showed that the nucleus pulposus produces local inflammation and scarring in the epidural space in dogs. Further, in humans, microstructural defects accumulate over time with age, and the nucleus pulposus protrudes deeper into the annulus, resulting in tears of the annulus and disc material leaking into the epidural space [21]. This may result in epidural adhesion formation and pain related to it, based on rich innervation of the posterior longitudinal ligament, which is an important source of back pain associated with epidural adhesions [22].

Thus, in the present investigation, we have sought to evaluate the effectiveness of percutaneous neurolysis in managing chronic lumbar disc herniation and lumbar radicular pain with a systematic review and meta-analysis.

**MATERIALS AND METHODS**

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [26] was used for methodological and reporting quality of the systematic review and meta-analysis. The objective was to assess the effectiveness of percutaneous neurolysis in managing chronic lumbar disc herniation and radiculopathy.

1. **Inclusion criteria**

All randomized controlled trials (RCTs) and observational studies with inclusion of patients with chronic disc herniation, undergoing percutaneous neurolysis with caudal, lumbar interlaminar, or lumbar transforaminal approaches were considered.

2. **Outcome measures**

The proportion of patients with significant (≥ 50%) pain relief and improvement in function was the primary outcome.

3. **Data sources**

All available studies in the English language, or with available translation, with appropriate reporting of outcomes data for 6 months were included. Searches were performed using multiple databases, including PubMed (www.ncbi.nlm.nih.gov/pubmed); the Cochrane Library (www.thecochranelibrary.com); the US National Guideline Clearinghouse (www.guideline.gov/); clinical trials (www.clinicaltrials.gov/); and Google Scholar (https://scholar.google.com) from 1966 to January 2021.

4. **Search strategy**

The search terminology was as follows: ((((( ((((((((chronic low back pain) OR nerve root compression) OR lumbosciatic pain) OR radicular pain) OR radiculitis) OR sciatica) OR disc herniation) AND ((((((epidural injection) OR epidural adhesiolysis OR neurolysis) OR epidural neuroplasty) OR epidural lysis of adhesions) OR percutaneous adhesiolysis OR neurolysis `OR transforaminal injection) OR corticosteroid) OR methylprednisolone) OR bupivacaine OR lidocaine))) AND ((meta-analysis [pt] OR randomized controlled trial [pt] OR controlled clinical trial [pt] OR systematic review OR randomized controlled trials [mh] OR nonrandomized studies OR observational studies OR random allocation [mh] OR double-blind method [mh] OR single-blind method [mh] OR clinical trial [pt] OR clinical trials [mh] OR (“clinical trial” [tw]) OR ((singl* [tw] OR singl* [tw])))) OR ((((((((chronic low back pain) OR nerve root compression) OR lumbosciatic pain) OR radicular pain) OR radiculitis) OR sciatica) OR disc herniation) AND ((((((epidural injection) OR epidural adhesiolysis OR neurolysis) OR epidural neuroplasty) OR epidural lysis of adhesions) OR percutaneous adhesiolysis OR neurolysis `OR transforaminal injection) OR corticosteroid) OR methylprednisolone) OR bupivacaine OR lidocaine))) AND ((meta-analysis [pt] OR randomized controlled trial [pt] OR controlled clinical trial [pt] OR systematic review OR randomized controlled trials [mh] OR nonrandomized studies OR observational studies OR random allocation [mh] OR double-blind method [mh] OR single-blind method [mh] OR clinical trial [pt] OR clinical trials [mh] OR (“clinical trial” [tw]) OR ((singl* [tw] OR singl* [tw])))) AND (all studies) OF (all databases).
OR doubl* [tw] OR trebl* [tw] OR tripl* [tw]) AND (mask* [tw] OR blind* [tw])) OR (placebos [mh] OR placebo* [tw] OR random* [tw] OR research design [mh:noexp]]).

5. Data collection and analysis

This review focused on percutaneous adhesiolysis/neurolysis for disc herniation with multiple approaches. All studies that provided appropriate outcome data and analysis for 6 months were reviewed. Book chapters, case reports, and reports without an appropriate diagnosis were not considered.

6. Inclusion criteria

Studies of interest included patients suffering from chronic lumbar radiculopathy due to disc herniation and treated with percutaneous epidural neurolysis or adhesiolysis. Studies of patients with fractures, malignancies, acute trauma, and inflammatory diseases were excluded. All RCTs and non-randomized studies with inclusion of at least 50 participants were included.

7. Data collection process

Identification of the relevant literature, the manuscript selection, and extraction of the data from the included studies was conducted independently by 2 of the review authors. Any disagreement between them was resolved by the third author. Any and all conflicts of interest of the reviewers with authorship of the manuscripts was resolved by assigning them to other reviewers.

8. Data synthesis and analysis

Two authors completed the quality assessment of each individual manuscript. Three authors completed evidence synthesis. All conflicts were resolved as stated above by a fourth author.

9. Risk of bias of individual studies

The quality of each RCT was assessed using the Cochrane review rating system (Appendix Table 1) [27] and Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment Tool (IPM-QRB) for RCTs (Appendix Table 2) [28]. Non-randomized or observational studies were assessed by Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for nonrandomized or observational studies (IPM-QRBNR) (Appendix Table 3) [29].

Randomized trials meeting at least 9 of the 13 inclusion criteria of the Cochrane review were considered high-quality. The trials meeting 5 to 8 criteria were considered moderate-quality, and those meeting fewer than 5 criteria were considered low-quality, and were excluded.

Based on the IPM-QRB and IPM-QRBNR criteria, randomized trials and observational studies meeting scores from 32 to 48 were considered high-quality, studies scoring from 16 to 31 were considered moderate quality; and studies scoring less than 16 were considered low quality, and were excluded.

| Table 1. Qualitative modified approach to grading of evidence |
|---------------------------------------------------------------|
| **Level I** | **Strong** | Evidence obtained from multiple relevant high-quality randomized controlled trials for effectiveness or Evidence obtained from multiple relevant high quality observational studies or large case series for assessment of preventive measures, adverse consequences, and effectiveness of other measures. |
| **Level II** | **Moderate** | Evidence obtained from at least one relevant high-quality randomized controlled trial or multiple relevant moderate or low-quality randomized controlled trials or Evidence obtained from at least 2 high-quality relevant observational studies or large case series for assessment of preventive measures, adverse consequences, and effectiveness of other measures. |
| **Level III** | **Fair** | Evidence obtained from at least one relevant high-quality nonrandomized trial or observational study with multiple moderate or low-quality observational studies or At least one high-quality relevant observational studies or large case series for assessment of preventive measures, adverse consequences, and effectiveness of other measures. |
| **Level IV** | **Limited** | Evidence obtained from multiple moderate or low-quality relevant observational studies or Evidence obtained from moderate quality observational studies or large case series for assessment of preventive measures, adverse consequences, and effectiveness of other measures. |
| **Level V** | **Consensus based** | Opinion or consensus of large group of clinicians and/or scientists for effectiveness as well as to assess preventive measures, adverse consequences, and effectiveness of other measures. |

Adapted from the article of Manchikanti et al. (Pain Physician 2014; 17: E319-25) [30].
10. Outcome of the studies

Clinically important outcome measures of 50% significant improvement from the baseline pain score, or a change of at least 3 points on an 11-point pain scale of 0 to 10 and a change of 30% or more on disability scores.

Based on the relevance and effectiveness of the neurolysis in disc herniation, either compared to a control group or from baseline to follow-up, a study was categorized as positive or negative/neutral. Reference point measurements were considered at 3 months, 6 months, and one year.

11. Analysis of evidence

The best-evidence synthesis developed by the American Society of Interventional Pain Physicians, modified and collated using multiple criteria, was used for qualitative analysis (Table 1) [30]. The evidence synthesis varied from strong to opinion- or consensus-based using 5 levels of evidence.

12. Meta-analysis

Software Review Manager (Rev Man 5.3) was used (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark, 2008) for conventional or dual-arm meta-analysis. Software Comprehensive Meta-analysis version 3.0 was used (Biostat Inc., Englewood, NJ) for single-arm meta-analysis. The standardized mean differences with 95% confidence intervals were reported for pain and improvement of function data. Data were plotted by using forest plots to evaluate treatment effects. Heterogeneity was interpreted through $I^2$ statistics.

RESULTS

1. Study selection

Fig. 1 shows a flow diagram of the study selection using the PRISMA study selection process [26].

Based on the search criteria, 13 manuscripts were identified and considered for inclusion [18,25,31-41]. A total of 6 studies met the inclusion criteria [25,31,33,37,38,40]. Of the 6 studies included, 2 of them [18,41] studied disc prolapse, along with post-lumbar surgery syndrome, and subgroup data analysis was not available. One study had a small sample size of 20 patients [34].

Four studies were excluded due to short-term follow-up of 6 months since less than a 3-month follow-up would not provide any long-term clinical relevance [32,35,36,39]. Of these, there was only one placebo-controlled RCT [25].

2. Methodologic quality and risk of bias assessment

Of the 6 manuscripts meeting inclusion criteria [25,31,33,37,38,40], there was only one placebo-controlled RCT [25]. Appendix Tables 4 and 5 show the methodologic quality assessment and risk of bias of the one RCT utilizing the Cochrane review criteria and the IPM-QRB criteria respectively [27,28]. Assessment by the Cochrane review criteria and IPM-QRB of this RCT showed high quality [25].

Appendix Table 6 shows the assessment of the included nonrandomized or observational studies, utilizing IPM-QRB NR criteria. Five studies [31,33,37,38,40] were included. Assessment by IPM-QRB NR showed all studies to be of moderate quality.

3. Study characteristics

Table 2 shows the characteristics and outcomes of the studies meeting the inclusion criteria which involved receiving percutaneous adhesiolysis/neurolysis for lumbar disc herniation.

4. Qualitative analysis

Qualitative analysis was performed utilizing a modified
Table 2. Characteristics of included studies of percutaneous adhesiolysis/neurolysis in lumbar disc herniation

| Study characteristics | Methodological quality scoring | Participants and interventions | Outcome measures | Pain relief and function | Results | Comment(s) |
|-----------------------|--------------------------------|--------------------------------|-----------------|--------------------------|---------|------------|
| RA, PC, DB            | Cochrane: 113/13, IPM-QRB 41/48| The authors screened 90 patients from 381 patients with chronic radicular pain lasting longer than 4 months over a period of 4 years. Randomization: Placebo control group = 44. | 3 mo 6 mo 12 mo | Placebo group = 17% Placebo group = 11% Placebo group = 35% | Placebo group = 11% Placebo group = 46% Placebo group = 74% | This is the first true placebo controlled trial, injecting and inert substance into an inert structure, yet it showed positive response in some patients. Overall, there were significant differences in the active treatment group and lysis group compared to placebo group. Ten year follow-up also showed significant improvement and surgery was avoided in majority of the patients. Surgery was avoided in 85% of the patients. |
| Chronic lumbar radicular pain lasting longer than 4 months |                                  | In the placebo group, a needle and catheter was inserted through caudal approach and the needle was intentionally inserted without entering the spinal canal and the catheter was inserted into the subcutaneous tissue overlying the afflicted level. | Primary outcome measure: ODI at 3, 6, and 12 months. VAS: At least 50% reduction in ODI scores and VAS scores at 3, 6, and 12 months after treatment | Placebo group = 58% Placebo group = 74% Placebo group = 90% | Placebo group = 58% Placebo group = 74% Placebo group = 90% | |
| Gerdemaner et al., 2013 [25] |                                  | 10 mL of preservative-free sodium chloride solution was injected for 3 days and the catheter was removed. Neurolysis group = 46. The catheter was placed through sacral canal with injection of 10 mL of contrast with identification of filling defects. Subsequently a Tun-L catheter was inserted through the epidural needle and advanced to the anterolateral area of the filling defect. | | | | |
|                                  |                                  | Local anesthetic, 10 mL, 0.25% bupivacaine was injected through the catheter, followed by 10 mL of preservative free sodium chloride solution containing 150 units per mL of hyaluronidase. | | | | |
|                                  |                                  | Sodium chloride solution, 10 mL, 10%, containing 40 mg of triamcinolone was then injected slowly, along with 2 mL of 0,25% bupivacaine. | | | | |
|                                  |                                  | On the 2nd and 3rd days, 10 mL of 0.25% bupivacaine was injected through the catheter, followed by slow injection of 10 mL of 10% sodium chloride solution and 2 mL, 0.25% bupivacaine. The catheter was removed on the third day in both groups. | | | |
### Table 2. Continued

| Study characteristics | Methodological quality scoring | Participants and interventions | Outcome measures | Pain relief and function | Results |
|-----------------------|-------------------------------|--------------------------------|-----------------|---------------------------|---------|
|                       |                               |                                | 3 mo   | 6 mo   | 12 mo | Short-term | Long-term | Comment(s) |
| Ji et al., 2015 [40]  | Retrospective Lumbar disc herniation | Quality Scores: IPM-QRB-NR 30/48 | Authors studied correlation of dural sac cross sectional area with a single-level disc disease and effectiveness of percutaneous epiduroplasty. Number of patients = 363 Categorization to spinal canal compromise Category 1 – less or more than 50% Category 2 – lesser than one-third, between a third and two-thirds, and more than two-thirds with subcategories • Catheterization was performed with a caudal approach. After final positioning of the Racz catheter, 6 mL of 0.2% preservative free ropivacaine containing 1,500 units of hyaluronidase and 4 mL of 40% triamcinolone acetate was injected. • One-hour after the procedure, 6 mL of 8% sodium chloride solution was infused over 30 minutes in the recovery room under monitoring. • Epidural catheter was removed. | VAS for back pain and leg pain, Odom’s criteria Assessment intervals: 3, 6, 12, and 24 months | SI in VAS | SI in VAS | SI in VAS | SI in VAS | SI in VAS | ≤ 3 mo | > 6 mo | ≥ 12 mo | This study looking at dural cross sectional area in single level disc disease showed no significant difference based on dural sac cross sectional area. The results show that percutaneous epidural neuroplasty is an effective procedure in treating single-level lumbar disc herniation without affecting dural sac cross sectional area. |
| Moon et al., 2017 [33] | Retrospective Lumbar disc herniation | Quality Scores: IPM-QRB-NR 30/48 | 407 patients were evaluated retrospectively to predict the outcome of percutaneous epidural adhesiolysis in patients with lumbar disc herniation. All patients underwent percutaneous adhesiolysis with an RK needle and Racz catheter through caudal approach. After final positioning of the catheter in the anterior epidural space of the target site, 3-5 mL of 1% lidocaine was administered as a test dose. This was followed by 10 mL of 0.9% sodium chloride solution, followed by injection of 0.125% bupivacaine mixed with 5 mg of dexamethasone. • After 5 minutes, 10 mL of 10% sodium chloride solution was slowly injected under real-time fluoroscopic guidance. • Catheter was removed and insertion site was sutured. | The primary outcome measure was substantial response of 4 or more points or 50% of pain relief in the numerical rate scaling pain score, 12 months after treatment. Repeat procedure was performed if needed at 3 months. Six-months not available. | NA | NA | SI in VAS | NA | NA | P | This is a positive study with long-term follow-up assessing factors predicting favorable outcome of percutaneous epidural adhesiolysis. The presence of high intensity zone on magnetic resonance imaging was a predictor of substantial response to percutaneous epidural adhesiolysis for 12 months. |
## Table 2. Continued

| Study | Study characteristics | Methodological quality scoring | Participants and interventions | Outcome measures | Pain relief and function | Results | Comment(s) |
|-------|-----------------------|--------------------------------|-------------------------------|------------------|--------------------------|---------|------------|
| Cho et al., 2019 [31] | Retrospective Lumbar disc herniation | Quality Scores: IPM-QRB NR 30/48 | • This study included 430 consecutive patients with a single-level disc herniation undergoing percutaneous epidural neuroplasty. Authors categories LDH type as bulging, protrusion, extrusion, and sequestration. LDH type inclusion: bulging 124, protrusion 240, extrusion 56, sequestration 10, total 430. • All patients were treated with percutaneous adhesiolysis or neuroplasty through a caudal approach with placement of the catheter ventrally and laterally. Following the satisfactory positioning of the catheter and injection of contrast, 6 mL of 0.2% preservative free ropivacaine containing 1,500 units of hyaluronidase and 4 mL of betamethasone sodium phosphate was injected. • One hour after the procedure, 6 mL of 8% sodium chloride solution was infused over a period of 30 minutes under monitoring in the recovery room. Epidural catheter was removed. | VAS for back pain and leg pain, Odom’s criteria with classification of outcomes as excellent, good, fair or poor. Outcomes were recorded at 1, 3, 6, and 12 months | Significant decrease in VAS scores for back and leg pain | Good or excellent outcome = 73.1 | Overall, this is a positive study with positive results with a single treatment of one-day percutaneous adhesiolysis providing improvement in VAS of back and leg pain lasting for one-year. Surgery was avoided in more than 70% of the patients with extrusion or sequestration. Patients with Pfirrmann’s Grades 1 to 3, shows a significantly higher rate of subsequent surgery than with Pfirrmann Grade 0. |
Table 2. Continued

| Study | Study characteristics | Methodological quality scoring | Participants and interventions | Outcome measures | Pain relief and function | Results | Comment(s) |
|-------|-----------------------|--------------------------------|--------------------------------|------------------|-------------------------|---------|------------|
|       |                       |                                |                                |                  | 3 mo 6 mo 12 mo          | Short term Long term |           |
| Park et al., 2018 [37] | Retrospective Lumbar disc herniation and/ or spinal stenosis | Quality Scores: IPM-QRB-NR 29/48 |Authors sought to evaluate clinical significance of epidurography contrast patterns after adhesiolysis. Number of patients = 78 • Both spinal stenosis and disc herniation patients were included without separating the data. • Procedure was performed with caudal entry. After appropriate positioning of the catheter, a mixture of 10 mL of 0.9% sodium chloride solution and 300 units of hyaluronidase was injected. Following this, another epidurogram was carried out. After epidurogram a mixture of 0.2% ropivacaine 8 mL and 40 mg of triamcinolone was slowly injected. • Significant improvement in VAS scores, back pain and leg pain • Significant improvement in ODI scores • Extraforaminal leakage of the contrast was associated with a tendency for decreased pain and significant better quality of life. | VAS, ODI, 12-item short-form health survey (SF-32) Outcomes assessed at 1, 3, 6, and 12 months | SI SI SI | P P P | In this study assessing clinical significance of epidurography contrast patterns, authors reported positive results and authors also showed that when there is extraforaminal contrast spread, outcomes were superior. |
### Table 2. Continued

| Study                     | Study characteristics | Methodological quality scoring | Participants and interventions                                                                                                                                                                                                 | Outcome measures | Pain relief and function | Results | Comment(s)                                                                 |
|---------------------------|-----------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------|---------|---------------------------------------------------------------------------|
| Choi et al., 2017 [38]    | Retrospective         | Lumbar disc herniation and/or spinal stenosis | - This study included 543 patients assessing 5% or 10% hypertonic sodium chloride solution injection.  
- 5% group = 333  
- 10% group = 210  
- Procedure was performed with a caudal entry and catheterization after final catheter position was achieved. 5 mL of 0.25% ropivacaine containing 1,500 units of hyaluronidase was injected. After confirming the absence of any complications, 6 mL of 10% or 5% sodium chloride solution was injected at a rate of 1 mL every 15 minutes for 1.5 hours. This was followed by injection of 2 mL of 0.9% sodium chloride solution containing 40 mg of triamcinolone.  
- Epidural catheter was removed before discharging the patients. | NRS               | No significant differences between the groups.  
Both groups showed significant improvement in pain rating.  
Both groups showed significant improvement in pain rating. | NA      | P  
P  
NA | Short-term follow-up with positive outcomes showing no significant difference between 5% or 10% sodium chloride solution.  
RA: randomized, PC: placebo control, DB: double-blind, ODI: Oswestry Disability Index, VAS: visual analog scale, SI: significant improvement, NA: not applicable, P: positive, IPM-QRB: Interventional Pain Management techniques – Quality Appraisal of Reliability and Risk of Bias Assessment, IPM-QRB-NR: Interventional Pain Management Techniques – Quality Appraisal of Reliability and Risk of Bias Assessment for Non-randomized Studies, NRS: numeric rating scale, LDH: lumbar disc herniation.
approach for the grading of evidence [28] with moderate (level II) evidence from one relevant high-quality RCT and 5 relevant moderate-quality observational studies. All of the studies consistently showed improvement in patients undergoing neurolysis at 6 months and one-year follow-up periods.

5. Quantitative analysis

1) Single-arm meta-analysis

Conventional dual-arm analysis was not feasible due to only one RCT being available. Consequently, single-arm meta-analysis was performed in observational studies for pain relief and functional status improvement, utilizing data from 5 studies [31,33,37,38,40].

2) 6-month follow-up

Fig. 2 shows results of the 6-month follow-up. As shown in Fig. 2A, there were 5 studies [25,31,37,38,40] included in this single-arm meta-analysis, and the results showed an improvement in the numeric rating scale (NRS) pain scores at 6 months after adhesiolysis/neurolysis, with an average of 2.678 (P < 0.001).

As shown in Fig. 2B, there were 2 studies [25,37] included in this single-arm meta-analysis, and the results showed an improvement in the Oswestry Disability Index (ODI) functionality scores after adhesiolysis/neurolysis at 12 months, with an average of 10.268 (on 0-50 scale) (P < 0.001).

3) One-year follow-up

Fig. 3 shows results of the one-year follow-up. As shown in Fig. 3A, there were 5 studies [25,31,33,37,40] included in this single-arm meta-analysis, and the results showed an improvement in the NRS pain scores at 12 months after adhesiolysis/neurolysis, with an average of 2.013, which was statistically significant (P < 0.001).

As shown in Fig. 3B, there were 2 studies [25,37] included in this single-arm meta-analysis, and the results showed an improvement in the Oswestry Disability Index (ODI) functionality scores after adhesiolysis/neurolysis at 12 months, with an average of 10.268 (on 0-50 scale) (P < 0.001).

**DISCUSSION**

Analysis of the effectiveness of percutaneous adhesiolysis/
neurolysis in managing lumbar disc herniation showed Level II or moderate evidence in the present systematic review and meta-analysis, which included one RCT and 5 observational studies with at least 6 months of follow-up in one study and 12 months of follow-up in all the others. The single RCT by Gerdesmeyer et al. [25], in a well-designed, relevant, high-quality RCT, studied 90 patients in the placebo group. In the placebo design, a needle and catheter were inserted through a caudal approach. The needle was intentionally inserted without entering the spinal canal and the catheter was inserted into the subcutaneous tissue overlying the afflicted level. In the neurolysis group, the catheter was placed over the lumbar spine with adhesiolysis, followed by an injection of local anesthetic, hyaluronidase, and a steroid. In both groups, the catheters were left for 3 days and additional injections were performed.

The results showed, at one year, greater than 50% improvement in the ODI was seen in 90% of the patients in the neurolysis group, whereas it was seen in 35% of the patients in the placebo group. In reference to the observational studies, all 5 studies [31,33,37,38,40] were of moderate quality with inclusion of a large number of patients. Of the 5 studies meeting inclusion criteria, only one study by Park et al. [37] had less than 100 patients, with an inclusion of 78 patients. However, the other 4 studies included a large patient population ranging from 363 to 543 [31,33,38,40]. Total number of patients included in the observational studies were 1,821, assessing the role of percutaneous neurolysis in managing lumbar disc herniation or chronic lumbar radiculopathy. Consequently, the results of this study provide robust evidence from one high-quality RCT [25] and 5 observational studies [31,33,37,38,40] with a large proportion of patients with at least one-year follow-up in 4 studies [31,33,37,40] and 6-month follow-up in one study [38]. Overall, the number of patients included in long-term follow-up, including the RCT, were 1,268.

The present investigation is the first systematic review and meta-analysis focused on determining the role of neurolysis in managing chronic recalcitrant disc herniation or chronic lumbar radicular pain. The results of this systematic review and meta-analysis are similar to the results of systematic reviews and meta-analyses performed in post-lumbar surgery syndrome and central spinal stenosis [12-16]. Caudal epidural injections have been used since 1901, with a description of entering the epidural space from the sacral hiatus [1,42,43]. Epidural injections are also performed with an interlaminar or transforaminal approach [1]. However, the caudal approach, even though it requires
higher volumes, has been considered the safest and earliest technique. The most common approach for percutaneous neurolysis is through the sacral hiatus [1]. The majority of the studies were related to entry through the sacral hiatus. Administration of steroids in the epidural injections was described by Robecchi and Capra [44] and Lievre et al. [45] in 1952 and 1953. Effectiveness, safety, cost utility, and utilization patterns of epidural interventions have been extensively described [1,10,46-50].

Epidural injections have been shown to be with level I evidence in managing disc herniation or chronic lumbar radiculopathy with all 3 approaches, namely caudal, interlaminar, and transforaminal [1]. However, there also have been negative studies in the literature as well [51]. There have been significant discussions on this subject, including various types of bias in studies in interventional pain management [1,10]. In fact, Manchikanti et al. [10] performed a comparative systematic review and meta-analysis of the study by Chou et al. [51], which showed significantly different results when the analysis was performed utilizing methodology that did not convert active-controlled trials to placebo-controlled trials. Similar issues were also raised with findings of systematic reviews in assessing multiple interventional techniques, including the effectiveness of percutaneous adhesiolysis in post-lumbar surgery syndrome [13,15,16,52].

Limitations of this systematic review include lack of multiple RCTs, and the large scale observational studies are of only moderate quality.

In conclusion, the present systematic review and meta-analysis of epidural neurolysis in management of chronic recalcitrant disc herniation or lumbar radiculopathy shows level II evidence, based on one relevant, high-quality RCT [25] and 5 relevant moderate-quality observational studies [31,33,37,38,40]. The present analysis has not shown any significant side effects or complications derived from these studies.

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CONFLICT OF INTEREST

Dr. Hirsch is a consultant for Medtronic and Senior Affiliate Research Fellow at the Neiman Policy Institute.

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