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Clinical Studies

Real-world treatment patterns and management gaps of lumbar disc herniation in the United States

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ABSTRACT

Background: Lumbar disc herniation (LDH) affects approximately 1% to 3% of the population annually and leads to substantial physical burden, quality-of-life burden, and productivity loss. Commonly used interventions, including pharmacological and epidural steroid injections (ESIs), have limited high-quality evidence to support their effectiveness in the long-term for treating LDH beyond symptom relief. In general, there is a lack of consensus for timing of treatment after LDH onset and limited data on real-world treatment of LDH. The objective of this study was to describe current real-world treatment patterns and inform gaps in clinical management of patients with LDH.

Methods: A retrospective analysis was performed using data from January 01, 2018 through March 31, 2023 of a United States commercial health insurance claims database (IQVIA PharMetrics Plus). Patients aged 30–70 years with newly-diagnosed LDH and continuous insurance enrollment for ≥6 months before and ≥12 months after index (first) LDH diagnosis were included. Relevant billing codes were used to identify LDH, related treatments (nonpharmacologic, pharmacologic, invasive), and comorbidities. Demographic and clinical characteristics were summarized for the baseline (preindex) period. Treatment patterns were described over the follow-up period, up to 3 years after LDH diagnosis. Time from LDH diagnosis to ESI(s) and surgery(ies) were calculated.

Results: A total of 1,086,552 patients with LDH were included, with a mean age of 50.8 years. Patients had a mean follow-up of 27 months after LDH diagnosis. Nearly 20% of patients with LDH underwent ESI, with half of this group undergoing multiple ESIs. Multiple ESIs were associated with a greater likelihood of surgical intervention and repeat surgical intervention compared to those who only underwent single ESI. LDH surgery was performed on 7.2% of patients, approximately 10% of whom had multiple surgeries during follow-up. A large subset (44.1%) of patients who underwent LDH surgery did not have any ESI prior to surgery. General limitations of claims data analyses can include data misclassification, missing claims for diagnoses and procedures that were conducted, missing clinical information (severity of condition, insights into clinical decision making), and some missing patient demographics and characteristics.

Conclusions: In this study, approximately one quarter of patients with LDH underwent ESI and/or surgery after conservative treatment. Opportunities exist to provide more guideline-concordant care to patients with LDH. In addition, unmet needs exist in the current treatment options for patients with LDH, potentially including the need for other nonsurgical treatment options for patients who do not fully respond to conservative treatment.

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Introduction

Lumbar disc herniation (LDH) affects approximately 1% to 3% of the population annually, primarily individuals between 30 and 50 years of age [1,2]. Conservative treatment, the first-line treatment for most patients newly diagnosed with LDH, is usually effective for initial symptom relief (in approximately 90% of patients) and can include nonpharmacologic and pharmacologic therapies, typically attempted for 3 months before escalation of care [3–5].

When conservative therapy is insufficient to manage LDH symptoms, clinical practice guidelines recommend epidural steroid injection (ESI) as a potential treatment option [6–8]. ESI reliably offers only short-term pain relief (approximately 3 months), while the long-term efficacy is uncertain [9]. In fact, some patients undergo multiple ESIs in an attempt to relieve their LDH symptoms [10,11]. ESI also carries certain safety considerations, including an FDA warning about rare, serious neurological events [9,12–14].

For patients who do not achieve sufficient pain and disability relief from conservative treatment and ESI, lumbar discectomy is typically considered the next preferred treatment for LDH [15,16]. A waiting time of at least 6 to 8 weeks after LDH onset is suggested before surgery because of the probability of symptom resolution with no or conservative treatment in the majority of cases [15,17]. Lumbar discectomy for LDH appears to improve symptoms including leg pain in the short term, but these benefits may diminish over time [16,18–20]. Complication rates from LDH discectomy vary significantly, particularly across different surgical techniques, and range from approximately 10% to 20% and include intraoperative complications (nerve root injury, durotomy, bleeding, surgical error [e.g., wrong vertebral level]) and postoperative complications (infection, hematoma, reherniation, neurological deficits, reoperation) [21,22].

In general, there is a lack of consensus for timing of treatments after LDH onset, and few rigorous studies to support data-driven treatment paradigms in LDH. Practice patterns may differ from guideline-based management and vary depending on the patient’s pain level, employment status, and health insurance. Further, much of the data on real-world treatment of LDH examines a subset of treatments, e.g., only those patients undergoing surgery. This study seeks to describe current real-world treatment patterns and inform gaps in clinical management of patients with LDH, including the lack of effective minimally invasive treatment options [23].

Methods

Study design

This was a retrospective cohort study of treatment patterns and sequences in the clinical management of LDH, from a commercial health insurance claims database (PharMetrics Plus; IQVIA). The database contains de-identified information on enrollment history, patient demographics (including state information), detailed medical claims (e.g., diagnosis and procedure codes, provider specialty, inpatient stays, allowed/paid amounts), and pharmacy claims.

De-identified patient data were extracted for the period January 01, 2018 through March 31, 2023. This study was exempt from IRB approval as it was a retrospective analysis using secondary data with no interventions made to patients, and all patient data included in the analyses were de-identified.

Study population

Eligible patients were 30 to 70 years of age; with ≥1 inpatient or ≥2 outpatient diagnostic codes for the index (first) LDH during the study period; had continuous insurance enrollment for at least 6 months before the index date (baseline period); and continuous enrollment for at least 12 months after the index date (follow-up period); and had no ESI or LDH surgical procedure prior to the index date.

Study measures

LDH was identified by ICD-10 CM codes (see Supplementary Materials). Conservative treatments (including nonpharmacologic and pharmacologic treatments) were identified by Generic Product Identifier (GPI), Healthcare Common Procedure Coding System (HCPCS), and Common Procedural Terminology (CPT) codes. Conservative treatments included nonopioid analgesics (including nonsteroidal anti-inflammatory drugs, and acetaminophen), opioids, systemic glucocorticoids, benzodiazepines, antispasmodic agents, physical/massage therapy, spinal manipulation, and acupuncture. Procedures for ESI and lumbar surgery (e.g., laminotomy, laminectomy, discectomy, and endoscopic decompression procedure) were identified by CPT and HCPCS codes. This study did not include fusion procedures because it was focused on patients newly diagnosed with LDH; fusion is not a recommended surgery for these patients, and fusion is rarely used in clinical practice.

Comorbidities identified were those that are included in the Charlson Comorbidity Index (CCI) in addition to obesity, hypertension, scoliosis, osteoarthritis, fibromyalgia, depression, anxiety, and insomnia/sleep disorders [24,25].

Statistical analyses

Demographic and clinical characteristics during the 6-month baseline period were summarized and compared across subgroups defined by treatments received. Continuous variables were compared using a Wilcoxon rank sum test, and categorical variables were compared using a Chi-squared test.

Treatment patterns (including conservative treatments, ESI, and LDH surgery) were described over the follow-up period, up to 3 years. A unique treatment in the sequence was identified by a temporal pattern of codes for the same category of treatment (conservative, ESI, surgery); when a code for a different category of treatment was identified, a new step in the temporal sequence was demarcated. Conservative treatments were only counted in the first and last line of treatment. ESIs were counted up to the third event. Surgeries were counted up to the second event.

Time from index LDH diagnosis to first ESI and first surgery, and time from first ESI to second ESI, were described during the follow-up period among all eligible patients using a Kaplan-Meier analysis. Analyses were conducted with SAS, version 9.4.

Results

Demographics and baseline characteristics

A total of 1,086,552 patients with LDH were included in the analysis, with a mean (standard deviation [SD]) age of 50.8 (10.0) years and a mean (SD) CCI score of 1.2 (1.8) (Table 1). The most common comorbidities in this population included hypertension (28.2%), chronic pulmonary disease (25.9%), and diabetes (19.8%). Patients on average had more than 2 years of follow-up data (mean [SD]: 27.1 [8.5] months; median [interquartile range (IQR)]: 28 [19,36] months).

Utilization of ESI

Almost 1 in 5 patients with LDH received at least 1 ESI (19.8%; $n = 215{,}330$). Of the patients treated with any ESI, 52.4% received multiple ESIs. The mean (SD) number of ESIs received during follow-up was 2.0 (1.4).

Following a diagnosis of LDH (index date), 10.6% of patients with LDH (and 53.4% of those who received any ESI) received a first ESI

Table 1
Demographic and baseline characteristics.

	All patients with LDH N = 1,086,552	Treatment subgroups[†] Conservative/No treatment N = 836,811 (77.0%)	One ESI, No surgery N = 84,151 (7.7%)	Multiple ESI, No surgery N = 87,533 (8.1%)	Surgery[‡] N = 78,057 (7.2%)
Age at index LDH, years; mean (SD)	50.8 (10.0)	50.4 (10.1)	51.9 (9.7)*	52.6 (9.3)*	52.1 (9.8)*
Female; n (%)	585,050 (53.8)	460,825 (55.1)	43,826 (52.1)*	45,910 (52.5)*	34,489 (44.2)*
Duration of follow-up, months; mean (SD)	27.1 (8.5)	27.0 (8.5)	26.7 (8.5)	27.8 (8.3)	27.8 (8.2)
Prior conservative treatment; n (%)	720,578 (66.3)	529,12 (63.2)	63,705 (75.7)*	69,147 (79.0)*	58,564 (75.0)*
CCI score; mean (SD)	1.2 (1.8)	1.1 (1.7)	1.3 (1.9)*	1.4 (1.9)*	1.3 (1.9)*
Comorbidities; n (%)					
Hypertension	306,367 (28.2)	222,482 (26.6)	27,011 (32.1)*	30,983 (35.4)*	25,891 (33.2)*
Chronic pulmonary disease	281,785 (25.9)	209,369 (25.0)	23,768 (28.2)*	26,558 (30.3)*	22,090 (28.3)*
Diabetes	215,015 (19.8)	157,297 (18.8)	18,607 (22.1)*	21,035 (24.0)*	18,076 (23.2)*
Mild liver disease	157,740 (14.5)	117,147 (14.0)	13,566 (16.1)*	14,995 (17.1)*	12,032 (15.4)*
Osteoarthritis	117,649 (10.8)	81,310 (9.7)	12,059 (14.3)*	14,228 (16.3)*	10,052 (12.9)*
Obesity	115,802 (10.7)	86,708 (10.4)	9,773 (11.6)*	11,377 (13.0)*	7,944 (10.2)

CCI, Charlson comorbidity index; ESI, epidural steroid injection; LDH, lumbar disc herniation; SD, standard deviation.
* $p < .001$ vs. the conservative/no treatment group.
† Percentages are calculated as a proportion of the treatment subgroup.
‡ Represents all patients with surgery, 43,646 of whom also received ESI during the follow-up period.

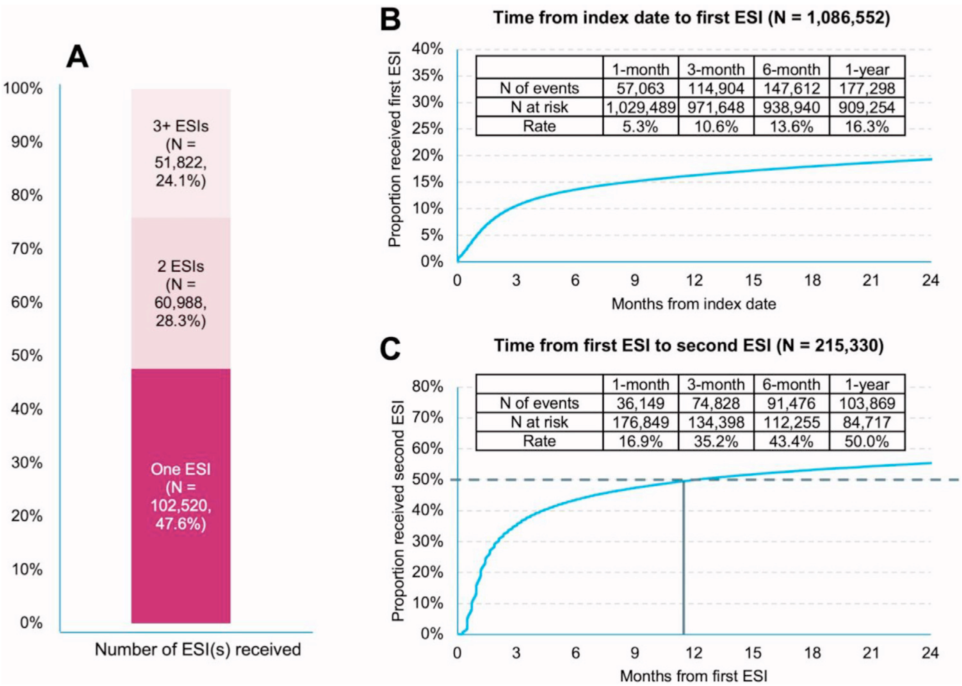

Fig. 1. Utilization and timing of ESI. (A) The bar graph depicts the distribution of patients who received ≥1 ESI (n = 215,330, 19.8%), showing the proportion who received 1, 2, or ≥3 ESI during the study period. (B) The time from LDH diagnosis to first ESI plotted using KM curve amongst the entire LDH patient population at risk. (C) The time from first ESI to second ESI plotted using KM curve amongst the subgroup of patients who received at least 1 ESI. ESI, epidural steroid injection; KM, Kaplan-Meier.

within 3 months, and 16.3% of all patients with LDH (and 82.3% of those who received any ESI) received the first ESI within 1 year (Fig. 1). Among patients treated with ESI, the median time from LDH diagnosis to first ESI was 2.6 months. The median time from the first to second ESI was approximately 1 year.

Utilization of surgery

LDH surgery was performed on 7.2% of patients with LDH (n = 78,057), most of whom (90.4%) had one surgery during the follow-up period (Fig. 2). Of patients who underwent surgery, the median time from LDH diagnosis to first LDH surgery was 5.3 months. Among patients who had surgery, 9.6% received multiple surgeries. Of all patients who underwent LDH surgery, 44.1% (n = 34,441) did not have any ESI during the study period (Fig. 3).

Of patients who were treated with ESI, 18.3% (n = 39,430) underwent subsequent LDH surgery, which represented 50.5% of the total group of patients undergoing LDH surgery. Patients treated by multiple ESIs were more likely to undergo LDH surgery (22.4% vs. 17.9%) and have repeat LDH surgery (12.8% vs. 9.4%) compared to patients who received only 1 ESI (Fig. 4).

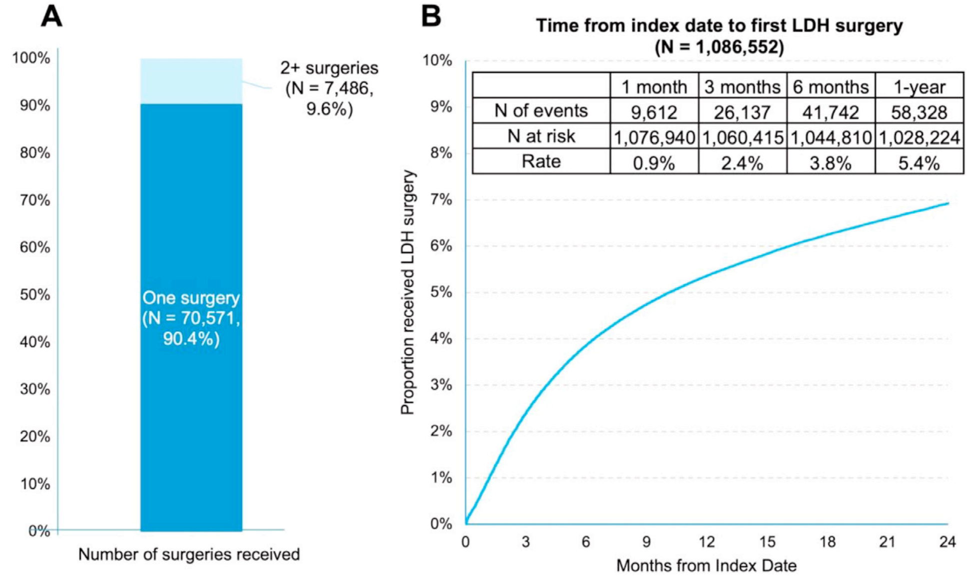

Fig. 2. Utilization and timing of surgery. (A) For the subgroup of individuals who had ≥1 LDH surgery during the study period (n = 78,057, 7.2%), the bar graph depicts the proportion who had 1 or ≥2 LDH surgeries. (B) The time from LDH diagnosis to first LDH surgery is plotted using KM curve amongst the entire LDH patient population at risk. LDH, lumbar disc herniation; KM, Kaplan-Meier.

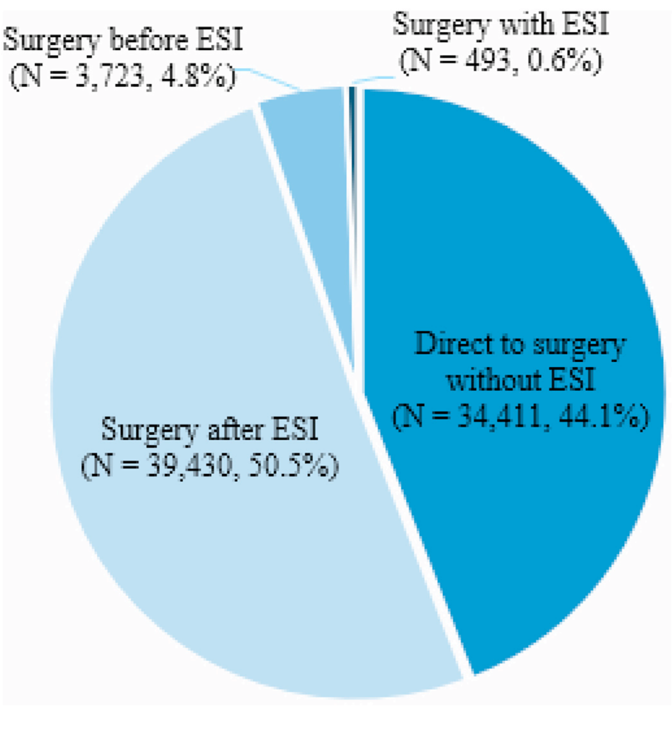

Fig. 3. Treatment patterns among patients with lumbar disc herniation (LDH) who underwent surgery. The bar plot illustrates the distribution of treatment patterns among patients with LDH who underwent surgery, including those who had LDH surgery after at least one or more ESI (50.5%), went directly to LDH surgery without receiving ESI (44.1%), had LDH surgery before receiving ESI (4.8%), or received LDH surgery with ESI on the same day (0.6%).

Treatment patterns and sequences

Almost all patients (98.4%) received conservative treatment during the follow-up period, and 23.0% of patients required invasive treatments (ESI and/or surgery) to manage their LDH. The group of patients who received invasive treatments were on average 1 to 2 years older and had a slightly lower proportion of female patients compared to patients who received no treatment or conservative treatments only (Table 1). Most patients (75.6%; n = 820,969) received only conservative treatments in this study. Only 1.5% (n = 15,842) of patients received no treatment after an LDH diagnosis.

Treatment sequences for patients who received invasive treatment (n = 249,741; 23.0% of the overall study population) are shown in Fig. 5. Among patients who received invasive treatment, most received ESI as the 2nd (78.6%) and/or 3rd (41.2%) treatment, and 15.4% did not receive any conservative treatment before invasive treatment(s). The most common treatment sequences were conservative treatment followed by 1 ESI (28.6% of patients), followed by 2 ESIs (16.1%), and followed by 3 ESIs (13.1%). Conservative treatment followed directly by 1 LDH surgery occurred in 11.0% of patients. Conservative treatment followed by 1 ESI and then 1 LDH surgery occurred in 5.1% of patients, and conservative treatment + 2 ESIs + 1 surgery occurred in 3.4% of patients.

Discussion

LDH poses a substantial burden on patients and the healthcare system. Due to the change of work and lifestyle habits, there has been a significant increase in LDH cases recently, with a trend towards a younger age of onset, resulting in a substantial societal impact [26]. This study adds to the existing literature by thoroughly describing current real-world treatment patterns of patients with LDH.

In this study, approximately one quarter of patients with LDH underwent invasive treatment after conservative treatment. Among patients who underwent any invasive treatment (ESI or surgery), 15% did not follow a suggested treatment pattern, i.e., a period of only conservative treatment as the first-line treatment, providing time for LDH to potentially resolve as it does in the majority of cases [3,4,15,17]. In addition, a notable proportion of the patients who underwent LDH surgery (44%) were treated with surgery without receiving any prior ESI, which could also be considered by some to be guideline-discordant treatment escalation. These treatment pattern choices could reflect unnecessary treatment of LDH or clinical features of LDH that suggested a need for more aggressive treatment.

In this study, half of the patients who received an ESI needed additional ESI(s) within 1 year, potentially indicating a lack of long-term efficacy. A separate retrospective claims analysis of 179,000 patients who underwent ESI (mean age 54 years) showed that 39% of

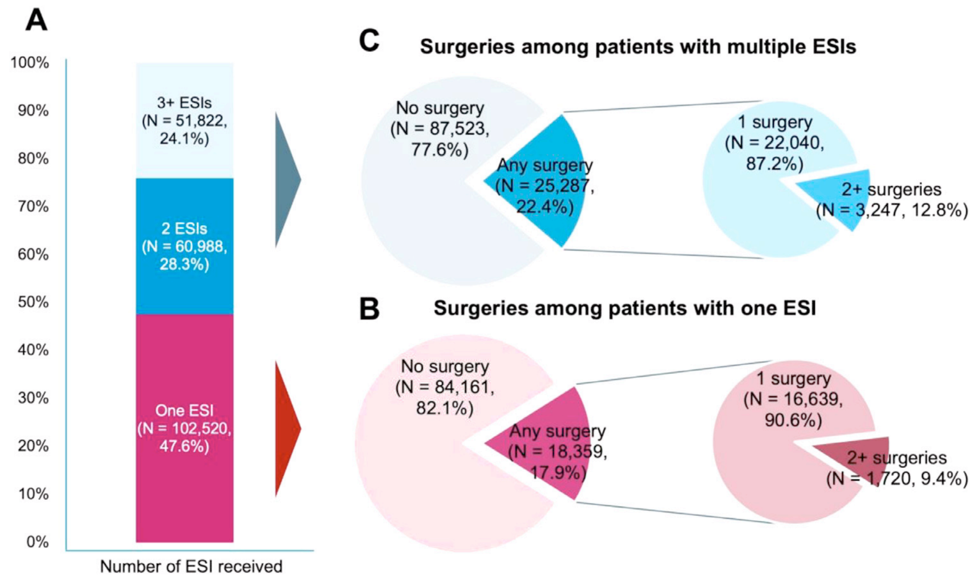

Fig. 4. Rate of LDH surgery in subgroups among patients who received ESI treatment. (A) The bar graph depicts the distribution of patients who received ≥1 ESI, showing the proportion of those who received 1, 2, or ≥3 ESI during the study period. (B) The pie chart represents the proportion of LDH surgery status within the subgroup of patients who received 1 ESI. (C) The pie chart represents the proportion of LDH surgery status within the subgroup of patients who received 2 or more ESIs.

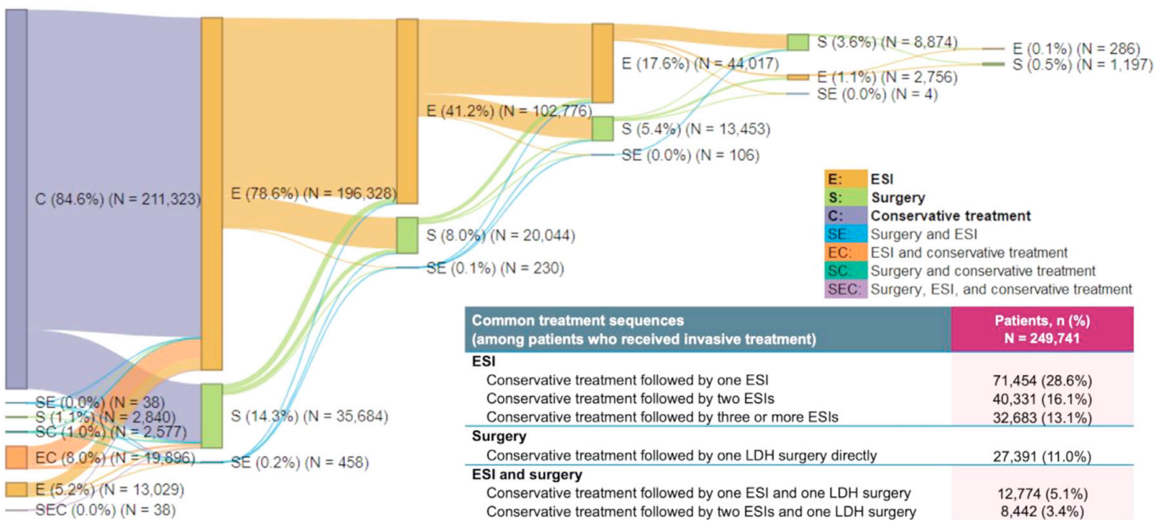

Fig. 5. Patient treatment flow at successive treatment stages among those who received invasive treatment(s) (23.0% of study population; $n = 249{,}741$). The Sankey diagram shows the proportion of patients who received a particular treatment (or treatment combination) at each step in the treatment sequence, up to the sixth treatment. After ESI or LDH surgery, patients could receive postprocedure recovery conservative treatment, which was not included in the figure. ESI, epidural steroid injection.

patients who had an index lumbar ESI for LDH or spinal stenosis had a repeat ESI within 1 year [27]. A single-center, retrospective cohort study of 933 patients (mean age 61 years) with radicular pain showed that 22% of patients needed repeat ESI within 1 year of the first injection, which provided a clinically minimal but statistically significant decrease in benefit with repeat injection(s) [10]. A prospective, single-center study of 78 patients with radicular leg pain and MRI-confirmed LDH showed a similar rate of 23% repeat ESI at the 5-year follow-up [11]. These claims data show higher rates of repeat ESI than other studies in the literature, potentially due to different study designs and populations that may limit their generalizability to a broader population.

Close to one-fifth of ESI-treated patients underwent surgery in this study, including some patients who received repeated surgeries. In another retrospective claims analysis of patients undergoing ESI for LDH or spinal stenosis, 17% of patients who had an index ESI subsequently had lumbar surgery within 1 year [27] We showed a rate of ∼10% of patients with LDH who had repeat surgery, in line with other reports in the literature showing 5% to 15% of patients undergo repeat spinal surgery for LDH [17,28,29].

Unmet needs exist in the current treatment options for patients with LDH, including the lack of effective nonsurgical treatment options for patients who do not fully respond to conservative treatment. ESI may provide temporary pain relief to patients with LDH, but many patients in this study underwent subsequent ESI(s). These data may reflect the conjecture in the literature that ESI is minimally effective in long-term management of LDH, though we are unable to fully assess treatment effectiveness in a claims analysis [9].

This study included a large population of patients with LDH who were continuously enrolled in commercial health insurance with ≥ 2-

year follow up, and provided a comprehensive picture on common LDH treatment sequences. The commercially insured patient population in this study may be more representative of the general US adult population than earlier single-center or small retrospective analyses [30,31].

Limitations of the study include the potential for misclassification inherent in claims data, as well as the lack of access to imaging results or clinical notes to confirm LDH diagnoses, information about the patient's LDH severity, and insight into clinical decision making [32]. Medical claims data captures only diagnostic and procedure codes that providers recorded for reimbursement purposes, and may not reflect the patient's entire medical history or treatment course. Outpatient pharmacy claims for a filled prescription do not guarantee that the patient took the medication. Information on some patient risk factors for LDH (e.g., smoking, BMI, genetic history) and patient characteristics (e.g., education level) as well as laboratory data are not available in the claims data. This study enrolled few patients over the age of 65 years, likely due to their enrollment in noncommercial insurance; however, older adults are less likely to undergo treatment for LDH as these outcomes, particularly after surgery, tend to be less favorable than in younger adults [12,33].

We did not capture the reasons for the clinician's decision to change/escalate treatments in the sequence, but we would assume treatment was changed due to failure of the previous treatment to achieve symptom relief (back pain, radicular leg pain) or emergent symptoms suggesting bowel/bladder dysfunction or cauda equina syndrome (which is a surgical emergency). There could be multiple factors that led to nonresponse to an earlier treatment in the sequence, including severity of disease, lack of efficacy, age, smoking status, comorbidities, and depression. However, treatment may have changed for other reasons, including patient preference, side effects, or nonmedical reasons.

In this large population of commercially-insured individuals with LDH, there appears to be a subset of patients who require multiple ESIs and surgical intervention for symptomatic relief. There also appears to be a separate group that proceeds to surgery after only conservative treatment or directly to surgery with no prior treatment. This may suggest a delineation between these groups in terms of their disease presentation and their treatment preferences.

Opportunities exist to provide more guideline-concordant care to patients with LDH. In addition, unmet needs exist in the current treatment options for patients with LDH, potentially including the need for other nonsurgical treatment options for patients who do not fully respond to conservative treatment. Future studies could examine the healthcare resource utilization and the economic burden of patients treated for LDH, especially for those patients who ultimately undergo LDH surgery.

Author contributions

Conceptualization: KC, AB, AG, MY, QL. Methodology: KC, AB, AG, MY, QL, YG. Data curation: MY, QL, YG, JL, SL, KC. Validation: YG, JL, SL. Formal analysis: YG, JL, SL. Writing, review, and editing: All authors.

Previous publication

A portion of these data were previously presented at the 26th Annual Meeting of the American Society of Interventional Pain Physicians, Dallas, Texas, April 4 to 6, 2024.

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Declaration of competing interests

One or more of the authors declare financial or professional relationships on ICMJE-NASSJ disclosure forms.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xnsj.2025.100757.

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