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A Retrospective Study on Perioperative Nursing with ERAS Protocol for Postoperative Rehabilitation after Unilateral Biportal Endoscopic Treatment of Lumbar Degenerative Diseases

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Abstract: *Objective*: To explore the clinical efficacy of perioperative nursing based on Enhanced Recovery After Surgery (ERAS) in patients receiving unilateral biportal endoscopy (UBE) for lumbar degenerative diseases (LDD), and to provide objective evidence for optimizing postoperative rehabilitation regimens. *Methods*: A total of 95 patients diagnosed with LDD who underwent UBE surgery from February 2024 to June 2025 were retrospectively enrolled and categorized into a conventional rehabilitation group (n = 49) and an ERAS group (n = 46) according to different postoperative rehabilitation protocols. The conventional group received routine traditional perioperative nursing, whereas the ERAS group was managed with a comprehensive perioperative regimen consisting of preoperative health education, preoperative nutritional support, preemptive analgesia, intraoperative humanistic care, and graded postoperative rehabilitation training. Baseline demographic data, health economic indicators including length of hospital stay and total hospitalization expense, as well as postoperative outcome indexes involving VAS, BI, and ODI scores, were statistically compared between the two cohorts. *Results*: No statistically significant intergroup differences were detected in baseline data ($p > 0.05$). From the perspective of health economics, the ERAS group yielded remarkably shorter hospital stay (7.89 ± 0.24 days vs 8.92 ± 0.41 days) and lower total hospitalization cost (32402 ± 592.1 CNY vs 35166 ± 1128 CNY), with statistically significant discrepancies ($p = 0.036$). In terms of postoperative functional recovery, the ERAS group achieved markedly lower VAS scores at postoperative day 5 and day 7 (1.70 ± 0.08, 0.44 ± 0.11 versus 2.14 ± 0.09, 0.82 ± 0.11, $p < 0.05$); the Barthel Index (BI) at postoperative day 2 was statistically higher in the ERAS group (65.87 ± 2.14 vs 58.57 ± 2.41, $p = 0.027$); meanwhile, the Oswestry Disability Index (ODI) measured at 3 months after surgery was significantly reduced in the ERAS cohort (21.43 ± 0.93 vs 25.62 ± 1.05, $p = 0.004$). *Conclusion*: The application of

ERAS-based standardized perioperative nursing in UBE surgery for LDD can effectively shorten hospitalization duration, cut down medical expenditure, accelerate postoperative pain relief, improve recovery of activities of daily living, and facilitate the rehabilitation of lumbar spinal function, which delivers prominent clinical and economic benefits and deserves widespread clinical promotion.

Keywords: Unilateral biportal endoscopy; Lumbar degenerative diseases; Enhanced recovery after surgery; Clinical efficacy; Perioperative nursing

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1. Introduction

Lumbar degenerative diseases (LDD) refer to a spectrum of prevalent clinical disorders pathologically characterized by intervertebral disc degeneration, intervertebral space stenosis, osteoproliferation, and ligamentum flavum hypertrophy, predominantly including lumbar disc herniation, lumbar spinal stenosis, and lumbar spondylolisthesis. Clinically affected patients commonly complain of lumbago, radiating lower-extremity pain, numbness, muscular weakness, and intermittent claudication, which severely compromise patients' quality of life [1]. Epidemiological statistics reveal that approximately 103 million individuals worldwide suffer from symptomatic lumbar spinal stenosis, while the lifetime prevalence of lumbar disc herniation reaches up to 23.9% [2]. Surgical intervention serves as the definitive therapeutic option for patients refractory to conservative management, with core operative goals focusing on decompression of compressed nerve roots, restoration of spinal biomechanical stability, and remission of associated clinical symptoms [3].

Unilateral Biportal Endoscopy (UBE) establishes an independent observation portal alongside a separate working access. Equipped with magnified endoscopic vision and flexible operative space, this minimally invasive technique enables precise neural decompression with minimal parenchymal injury and has been increasingly adopted for the surgical management of various lumbar degenerative pathologies [4]. Danish scholar Kehlet originally put forward the ERAS concept in the 1990s, which aims to mitigate surgical stress response and expedite postoperative rehabilitation via multidisciplinary and multimodal perioperative optimization protocols. Though relatively late to be introduced into spinal surgery, ERAS has gained rapid developmental momentum and evolved into a core optimization strategy for perioperative spinal care in recent years [5].

In this study, clinical data of LDD patients receiving UBE operation at the Department of Spine Surgery of the Sixth Affiliated Hospital of Sun Yat-sen University were retrospectively analyzed to make a cross-sectional comparison of postoperative rehabilitation, clinical efficacy, and health economic outcomes between ERAS-guided nursing and conventional nursing regimens, so as to provide empirical reference for individualized clinical protocol formulation.

2. Materials and methods

2.1. General clinical data

Ninety-five LLD patients who received UBE surgery between February 2024 and June 2025 were retrospectively recruited and split into a conventional rehabilitation group (n = 49) and an ERAS group (n =

46) based on divergent postoperative nursing schemes.

2.1.1. Inclusion criteria

(1) Confirmatory diagnosis of lumbar disc herniation, lumbar spinal stenosis, or other LDD via CT and MRI imaging, with clinical manifestations consistent with radiological findings;
(2) Progressive symptom aggravation after more than six months of ineffective conservative treatments, including pharmacotherapy, physical manipulation, and epidural injection, leading to compromised daily activities and occupational capacity;
(3) First-ever lumbar spinal surgery;
(4) Complete clinical and radiological follow-up data available for a minimum of 3 postoperative months.

2.1.2. Exclusion criteria

(1) Grade II or higher lumbar spondylolisthesis as well as severe scoliosis and kyphotic deformity;
(2) Past lumbar surgical history combined with spinal infection, spinal neoplasm, or spinal tuberculosis;
(3) Concurrent severe organic dysfunction of cardiac, pulmonary, hepatic, or renal systems incompatible with surgical tolerance;
(4) Coagulopathy or psychotic disorders interfering with surgical implementation and regular follow-up;
(5) Incomplete follow-up documentation.

2.2. Surgical protocols

A fixed experienced spinal surgical team completed all operative procedures. Preoperative systemic examinations were routinely implemented to localize pathological segments and customize individualized surgical plans in accordance with standardized operative specifications documented by Ouyang et al [5].

(1) Anesthesia and positioning

General anesthesia was administered, followed by prone positioning with suspended abdomen and moderate lumbar flexion to widen the interlaminar space; C-arm fluoroscopy was applied for precise segment localization.

(2) Portal establishment

Two 1-cm longitudinal incisions were made 2 cm para-spinally at the upper and lower margins of the target interlaminar space, separately allocated for observation and manipulation portals. Subcutaneous fascia was dissected sequentially, and paravertebral muscles were dilated to create a closed working cavity.

(3) Intraoperative manipulation

Continuous normal saline perfusion maintained at 50–60 cm hydrostatic pressure was adopted to keep the surgical field clear. A 30° endoscope was inserted via the observation channel; radiofrequency electrocautery was used for hemostasis and soft tissue release, followed by high-speed burr and rongeur laminotomy and flavum ligament resection to expose the dural sac and exiting nerve roots fully. For disc herniation cases, nerve retractors gently mobilized neural tissues for subsequent nucleus pulposus enucleation; for spinal stenosis patients, a unilateral approach, bilateral decompression was accomplished to ensure thorough clearance of lateral recess and central canal stenosis.

(4) Postoperative management

Meticulous hemostasis was performed under endoscopic visualization, followed by indwelling drainage tube implantation and layered wound closure covered with a sterile compressive dressing.

2.3. Nursing interventions

2.3.1. Control group (conventional perioperative nursing)

Patients were instructed to fast from 22:00 and prohibit oral intake after midnight on the preoperative day [6]. Standard pre-operative health education was delivered by in-charge nurses regarding disease pathogenesis, operative principles, postoperative routine rehabilitation, and relevant precautions; psychological counseling was provided for anxious patients. Vital signs were continuously monitored, and normothermia was maintained intraoperatively. Postoperative interventions included timely dressing change upon bleeding infiltration, dietary guidance, specification of waist orthosis wearing period, early functional training arrangement, and scheduled outpatient follow-up.

2.3.2. ERAS group (standardized ERAS multimodal perioperative nursing)

(1) Preoperative health education

Multimedia materials, including PPT and educational videos, were utilized to systematically elaborate disease etiology, surgical workflow, and full-course perioperative precautions; interactive Q&A sessions and targeted psychological intervention alleviated patients' preoperative dread and improved therapeutic compliance.

(2) Preoperative preparation

Personalized high-calorie, digestible dietary plans were formulated in line with individual eating habits. Consistent with ERAS criteria, patients with intact gastrointestinal function fasted solid food for 6 hours preoperatively and were permitted clear liquid intake up to 2 hours before anesthesia; carbohydrate-containing beverages were recommended 2 hours ahead for non-diabetic subjects [7]. Preemptive analgesia was initiated 8–12 hours prior to surgery. Nursing staff conducted proactive communication for emotionally distressed patients to emphasize the positive impact of mental stability on surgical success and subsequent recovery; warm towel skin cleaning was performed before ward transfer to minimize perioperative infection risks.

(3) Intraoperative humanistic management

Skin disinfection was strictly ensured before puncture under local anesthesia induction. Soothing background music was played throughout surgery alongside continuous real-time monitoring of body temperature, respiration, ECG, and blood pressure; casual chatting was adopted to distract nervous patients and ease psychological stress.

(4) Postoperative graded functional rehabilitation training

Within 12 h post-surgery: Alternating straight leg raise training, 5–10 min per session, four sessions daily with progressive elevation range. Postoperative Days 1–3: Wall-standing exercise requiring shoulder, hip, and heel tight against the wall for 5 min per time, five sets per day. One week after operation: Progressive core strengthening training including small swallow exercise (prone head-limb lifting, 10–15 repetitions per group, five groups daily), five-point supine bridging (supported by bilateral elbows, feet and occiput, hold for 3–5 s per lift, 10–15 times per set, three sets daily) and three-point bridging with crossed upper limbs (supported by feet and vertex, identical grouping specifications). Two weeks postoperatively: Gradual introduction of lumbar flexion training (supine knee hugging for maximum spinal flexion, 10 times per group, twice daily), prone push-up extension training, and torso rotation workout with alternating unilateral upper limb twist, two sets apiece every day.

(5) Discharge-directed nursing

Spinal specialized nurses collaborated with attending physicians to assess lumbar functional recovery and draft personalized home rehabilitation regimens; patients were required to wear lumbar orthosis continuously for six weeks and refrain from heavy manual labor for three months. A dedicated WeChat rehabilitation group was established for regular health education delivered by senior nurses and online real-time coaching administered by attending surgeons; compliant recovered patients were invited to share workout experience within the group to boost overall adherence, with a total follow-up duration of three months.

2.4. Outcome observation indicators

(1) Baseline data

Age, gender, stature, body weight, and BMI value.

(2) Health-economic indexes

Total length of hospital stays (from operative day to discharge), overall hospitalization expenditure.

(3) Postoperative functional scoring

VAS (Visual Analog Scale): assessed at 1 day before operation, 1 day, 3 days, 5 days, and 7 days after operation (0 = pain-free, 10 = unbearable severe pain); BI (Barthel Index): measured at 1 day before operation, 1 day, and 2 days after operation (full score = 100, higher score denotes superior self-care ability); ODI (Oswestry Disability Index): evaluated at 1 day before operation, 1 week, 1 month, and 3 months after operation (higher score indicates aggravated lumbar dysfunction).

2.5. Statistical analysis

All statistical analyses were processed via SPSS 22.0 software. Measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$); an independent samples *t*-test was adopted for intergroup comparison, while a Chi-square test was applied for enumeration data; $p < 0.05$ was defined as a statistically significant difference.

3. Results

3.1. Baseline characteristics comparison

Conventional group: 19 males, 30 females, aged 31–80 years, with an average age of 57.98 ± 2.11 years, a mean height of 160.6 ± 1.08 cm, an average body weight of 63.89 ± 1.69 kg, and a BMI ranging from 27.56 to 55.23 kg/m^2, with a mean of 39.71 ± 0.94 kg/m^2.

ERAS group: 20 males, 26 females, aged 13–83 years, with an average age of 56.00 ± 2.08 years, a mean height of 162.7 ± 1.24 cm, an average body weight of 63.20 ± 1.89 kg, and a BMI ranging from 27.74 to 58.14 kg/m^2, with a mean of 38.67 ± 0.98 kg/m^2.

No statistically significant intergroup discrepancies existed in age, gender, height, body weight, and BMI ($p > 0.05$), confirming comparable baseline conditions (**Table 1**).

Table 1. Comparison of baseline profiles between the two groups

Index		Conventional group (n = 49)	ERAS group (n = 46)	t/χ^2	*p*-value
Age(y)		57.98 ± 2.11	56.00 ± 2.08	0.67	0.507
Gender	Male	19	20	0.22	0.642
	Female	30	26	-	-
Height(cm)		160.6 ± 1.08	162.7 ± 1.24	1.30	0.197
Weight(kg)		63.89 ± 1.69	63.20 ± 1.89	0.27	0.788
BMI (kg/m^2)		39.71 ± 0.94	38.67 ± 0.98	0.76	0.447

3.2. Health-economic outcome comparison

The average length of hospital stay was 8.92 ± 0.41 days in the conventional group versus 7.89 ± 0.24 days in the ERAS group ($t = 2.13$, $p = 0.036$); total hospitalization cost stood at 35166 ± 1128 CNY vs 32402 ± 592.1 CNY, respectively ($t = 2.13$, $p = 0.036$). Both indicators achieved statistically significant superiority in the ERAS cohort (**Table 2**).

Table 2. Comparison of health-economic indicators

Index	Conventional group	ERAS group	*t*-value	*p*-value
Hospitalization(d)	8.92 ± 0.41	7.89 ± 0.24	2.13	0.036
Total cost (CNY)	35166 ± 1128	32402 ± 592.1	2.13	0.036

3.3. Postoperative functional scores comparison

On the day before surgery, the VAS scores were 3.41 ± 0.10 in the conventional rehabilitation group and 3.37 ± 0.10 in the ERAS group, with no statistically significant difference between the two groups ($t = 0.27$, $p = 0.787$), indicating comparable preoperative pain levels. On postoperative day 1, the VAS scores were 4.61 ± 0.08 in the conventional rehabilitation group and 4.61 ± 0.08 in the ERAS group, again showing no statistical difference ($t = 0.03$, $p = 0.974$). On postoperative day 3, the scores were 4.33 ± 0.11 in the conventional rehabilitation group and 4.07 ± 0.11 in the ERAS group, with no significant difference ($t = 1.62$, $p = 0.109$). On postoperative day 5, the scores were 2.14 ± 0.09 in the conventional rehabilitation group and 1.70 ± 0.08 in the ERAS group, revealing a statistically significant difference ($t = 3.85$, $p < 0.0001$), with lower VAS scores in the ERAS group. On postoperative day 7, the scores were 0.82 ± 0.11 in the conventional rehabilitation group and 0.44 ± 0.11 in the ERAS group, also showing a significant difference ($t = 2.34$, $p < 0.021$), with the ERAS group having lower VAS scores (**Table 3**).

Table 3. Serial VAS score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	3.41 ± 0.10	3.37 ± 0.10	0.27	0.787
Post-op D1	4.61 ± 0.08	4.61 ± 0.08	0.03	0.974
Post-op D3	4.33 ± 0.11	4.07 ± 0.11	1.62	0.109
Post-op D5	2.14 ± 0.09	1.70 ± 0.08	3.85	< 0.001
Post-op D7	0.82 ± 0.11	0.44 ± 0.11	2.34	0.021

On the day before surgery, the BI score of the conventional rehabilitation group was 93.57 ± 2.06 points, while that of the ERAS group was 95.43 ± 1.65 points. There was no statistically significant difference between the two groups (t = 0.70, p = 0.485). It can be concluded that the preoperative daily activity ability of the patients in both groups was the same, and they were comparable. On the first day after the surgery, the BI score of the conventional rehabilitation group was 39.39 ± 1.86 points, and that of the ERAS group was 40.76 ± 1.62 points. There was no statistically significant difference between the two groups (t = 0.55, p = 0.581). On the second day after the surgery, the BI score of the conventional rehabilitation group was 58.57 ± 2.41 points, and that of the ERAS group was 65.87 ± 2.14 points. There was a statistically significant difference between the two groups (t = 2.25, p = 0.027), and the BI score of the ERAS group was higher than that of the conventional rehabilitation group (**Table 4**).

Table 4. Serial BI score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	93.57 ± 2.06	95.43 ± 1.65	0.70	0.485
Post-op D1	39.39 ± 1.86	40.76 ± 1.62	0.55	0.581
Post-op D2	58.57 ± 2.41	65.87 ± 2.14	2.25	0.027

On the day before the operation, the ODI score of the conventional rehabilitation group was 19.15 ± 0.93 points, while that of the ERAS group was 16.78 ± 1.06 points. There was no statistically significant difference between the two groups (t = 1.68, p = 0.096), which suggests that the preoperative functional impairment degree of the patients in both groups was the same and they were comparable. The ODI score on the first week after the operation was 36.74 ± 1.03 points for the conventional rehabilitation group and 35.32 ± 1.47 points for the ERAS group. There was no statistically significant difference between the two groups (t = 0.80, p = 0.426). The ODI score on the first month after the operation was 32.07 ± 0.87 points for the conventional rehabilitation group and 30.44 ± 0.96 points for the ERAS group. There was no statistically significant difference between the two groups (t = 1.26, p = 0.212). The ODI score on the third month after the operation was 25.62 ± 1.05 points for the conventional rehabilitation group and 21.43 ± 0.93 points for the ERAS group. There was a statistically significant difference between the two groups (t = 2.97, p = 0.004), and the ODI score of the ERAS group was lower than that of the conventional rehabilitation group (**Table 5**).

Table 5. Serial ODI score comparison

Timing	Conventional group	ERAS group	*t*-value	*p*-value
Pre-op D1	19.15 ± 0.93	16.78 ± 1.06	1.68	0.096
Post-op W1	36.74 ± 1.03	35.32 ± 1.47	0.80	0.426
Post-op M1	32.07 ± 0.87	30.44 ± 0.96	1.26	0.212
Post-op M3	25.62 ± 1.05	21.43 ± 0.93	2.97	0.004

4. Discussion

The UBE technique creates dual independent access channels for continuous saline-irrigated spinal decompression, discectomy, and interbody fusion, combining minimally invasive endoscopic merits with flexible open-surgery operability. Recent clinical literature published by Professor Zhang's research team on the *International Journal of Surgery* verified that UBE application for elderly patients with lumbar spinal stenosis combined with degenerative scoliosis effectively reduces intraoperative hemorrhage and shortens operative duration, reflecting organic integration between minimally invasive surgery and ERAS philosophy [8]. Existing meta-analyses confirm that endoscopic minimally invasive spinal procedures serve as a core constituent of spinal ERAS protocols, yielding superior postoperative pain relief (VAS) and functional recovery (ODI) versus traditional open operations; UBE itself possesses inherent advantages facilitating accelerated postoperative rehabilitation [9]. Further implementation of standardized multimodal ERAS perioperative nursing upon the UBE baseline can optimize the whole rehabilitation trajectory [10]. Cumulative clinical evidence validates that ERAS bundled protocols shorten hospital stay, cut postoperative complication incidence, decrease opioid consumption, and curtail overall medical expenditure [11].

In this retrospective cohort research, ERAS nursing intervention significantly shortened hospitalization days and reduced total medical expense, elevating ward turnover rate and easing financial burden for both medical insurance funds and individual patients, which aligns with current medical insurance cost-control targets. No intergroup VAS discrepancy was identified on postoperative Day 1 and Day 3, while statistically lower pain scores emerged in the ERAS cohort starting from postoperative Day 5, demonstrating effective pain control via multimodal ERAS analgesic and nursing management to improve patients' in-hospital experience. BI indicator showed comparable outcomes on postoperative Day 1, with statistically improved daily living competence in ERAS subjects starting from Day 2, suggesting early functional benefit of ERAS rehabilitation protocol. Although short-term postoperative ODI revealed no prominent between-group difference, significant long-term functional improvement manifested at three-month follow-up, which proves ERAS nursing contributes to sustained reduction of chronic lumbar dysfunction after spinal surgery.

Collectively, UBE minimally invasive operation intrinsically conforms to the core tenets of the ERAS concept; systematic ERAS perioperative nursing further maximizes postoperative rehabilitation efficacy and complies with cost-saving medical insurance optimization goals. Nevertheless, domestic and international research concerning combined UBE-ERAS application remains in an exploratory stage with inconsistent implementation details across different clinical centers. Further controlled clinical trials are essential to standardize perioperative ERAS pathways and accelerate patient recovery.

Limitations of this study include inherent selection bias originating from retrospective design and relatively limited sample volume; long-term safety and efficacy require extended follow-up observation. Subgroup stratification by pathological segment quantity (single/multi-level lesion) and patient demographics (elderly, obese population) was not performed. Prospective large-sample multicenter research is warranted to supplement relevant clinical evidence in future investigations.

5. Conclusion

The application of ERAS-based standardized perioperative nursing in UBE surgery for lumbar degenerative disease (LDD) effectively shortens hospital stay, reduces medical costs, accelerates pain relief, improves daily living activities, and promotes lumbar functional recovery. These benefits demonstrate significant clinical and economic value, warranting broader adoption in clinical practice.

Disclosure statement

The authors declare no conflict of interest.

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