Efficacy of Enhanced Recovery After Surgery (ERAS) Protocols in Lumbar Microdiscectomy Surgery

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Abstract

Aim: This study aimed to assess the efficacy of enhanced recovery after surgery (ERAS) protocols in lumbar discectomy surgeries.

Methods: Data was obtained from 92 patients who underwent lumbar microdiscectomy surgery at a single institution between January 2021 and January 2023. Then, the patients were divided into two groups: ERAS protocol group (n=60), and conventional surgery group (n=32).

Results: The mean age of the patients was 49.4±14.0 years. Among these, 31 were females, and 61 were males. The demographic, surgical, and outcome parameters of the two groups were compared. There were statistically significant decreases in length of stay and spondylodiscitis rates in the ERAS protocol group. Length of stay was found 25.5±12.5 hours in the ERAS group, and 34.0±20.1 hours in the conventional surgery group (p=0.002). Spondylodiscitis rates were 3.3% and 15.6% in the ERAS and conventional surgery groups, respectively (p=0.034).

Conclusions: This study revealed that ERAS protocol reduces length of stay in hospital, and spondylodiscitis rates in lumbar microdiscectomy surgery. We conclude that ERAS protocols should be encouraged and applied more widely in spine surgeries.

Keywords: *Enhanced recovery after surgery, ERAS, spine, lumbar microdiscectomy, spondylodiscitis*

1. Introduction

ERAS (Enhanced Recovery After Surgery) protocol, which is a multidisciplinary approach consisting of evidence-based practices that are recommended to be applied before, during, and after surgery by many surgical departments, was first introduced by Kehlet et al. in 1997[1-3]. In the last two decades, much more comprehensive studies were carried out with large study groups[1,2,4,5]. ERAS protocols aim to optimize the process from the preoperative hospitalization to the postoperative discharge of a patient who is planned for surgical intervention.

The goals of these protocols are to reduce the metabolic stress in the human body as a result of surgical trauma, to enable patients to return to their daily life activities as soon as possible, and to reduce health expenditures[1,5,6]. This study aimed to assess the results of patients who underwent lumbar discectomy surgery with and without ERAS protocols.

2. Materials and methods

The research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (amended in October 2013), and Institutional Review Board approval was obtained. This study included 92 patients who underwent lumbar microdiscectomy surgery at a single institution between January 2021 and January 2023. The patients with recurrent/residual disc herniations, a history of posterior lumbar surgery or in need of posterior instrumentation, and the patients who were suffering from infectious or immunodeficiency diseases at the time of enrollment were excluded from the study. Patient data including age, gender, body mass index, comorbidities, tobacco use, American Society of Anesthesiologist (ASA) classification scores, symptoms, preoperative and postopera-

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tive visual analog scale (VAS) scores, surgery levels, complications, length of stay (LOS) in hospital, and patients' follow-up examinations were retrospectively gathered. ERAS protocols that are applied in the present study, are mentioned in Table 1.

2.1. Statistical analysis

Statistical Package for the Social Sciences (SPSS) software version 25.0 (IBM Corporation, Armonk, New York, United States) was used to analyze the variables. The Kolmogorov–Smirnov test was used to determine whether the parameters in the study showed normal distribution. Independent student t-test was used for parameters showing normal distribution, and Mann- Whitney U test was used for parameters not showing normal distribution. The quantitative variables were presented as mean ± SD (standard deviation) and the range (maximum-minimum) and categorical variables as n (%). The Pearson chi-square and Fisher's exact tests were used to compare the treatment and control groups in terms of the categorical variables. Spearman correlation analysis was used to identify risk factors for prolonged LOS. The variables were examined at 95% confidence level, and p<0.05 was considered significant.

3. Results

In the present study, 92 patients were enrolled with 60 (65.2%) patients classified into the surgery with ERAS protocol group, and 32 (34.8%) patients classified into the conventional surgery group. The mean age of the patients was 49.4±14 years (20-86 years). Among the 92 patients, 31 (33.7%) were females, and 61 (66.3%) were males. Patients' demographic data; including age, gender, body mass index, comorbidities, ASA scores, tobacco usage, and surgery levels, were compared between two groups and shown in Table 2. There were no statistically significant demographic differences between ERAS and conventional surgery groups (Table 2).

The surgical and outcome parameters of the two groups were compared (Table 3). There were statistically significant decreases in LOS (p=0.002) and spondylodiscitis rates (p=0.034) in the ERAS protocol group. LOS was found 25.5±12.5 hours in the ERAS group, and 34.0±20.1 hours in the conventional surgery group. There was not any statistically significant difference in the other parameters between two groups (Table 3). Prolonged surgical time (p=0.043) and diabetes mellitus presence (p=0.014) were identified to be the main risk factors for prolonged LOS.

The mean follow-up period of the patients was 14.7±7.2 months (3-27 months). Preoperative and postoperative VAS scores were compared between two groups and no statistically significant difference was found (Table 4). Among complications developed; there were 2 spondylodiscitis, 2 durotomy, and 1 reoperation in the ERAS group, and 5 spondylodiscitis, 2 durotomy, and 2 reoperation in the conventional surgery group. Spondylodiscitis rates were 3.3% and 15.6% in the ERAS and conventional surgery groups, respectively (p=0.034).

4. Discussion

ERAS pathways combine optimized clinical procedures with improved logistics and should cover preoperative and postoperative phases. It is very important to provide information about the disease, the complications of the operation, and the postoperative recovery process after a patient is diagnosed and decided to undergo surgery. There are studies in which there is strong evidence that knowing the current condition and postoperative events reduces the patient's anxiety[7-9]. In addition, it was observed that preliminary information significantly increased compliance with the preoperative and postoperative treatment process and decreased the need for perioperative narcotic and non-steroidal anti-inflammatory analgesics[8-11].

Comorbidities and smoking-alcohol usage should be carefully questioned before surgery. In the literature, there are studies with a high level of evidence, that quitting smoking and alcohol 4-8 weeks before the operation reduces the complications of the surgery.[10,12] The presence of preoperative malnutrition increases the risk of postoperative morbidity and mortality. In studies evaluating patients with serum-albumin levels below 3 g/dl, a significant relationship was found between postoperative infection and malnutrition.[13] It is recommended to evaluate the preoperative nutritional status and to start nutritional support 7-10 days before the operation[1].

Table 1
ERAS protocols that are applied in the present study

ERAS Protocol		
Preoperative	**Perioperative**	**Postoperative**
Preliminary information	Standard anesthesia protocol	Early mobilization
Preoperative nutritional evaluation and supplementation	Antimicrobial prophylaxis	Prompt nutrition
Prehabilitation	Optimal fluid management	Avoidance of nausea and vomiting
Tobacco and alcohol quitting	Opioid free analgesia	Opioid free analgesia
Anemia assessment	Small skin incision	
Carbonhydrate loading	Avoidance of surgical drain and Foley catheter	
Shortened fasting	Avoidance of hypothermia	
Optimal analgesia		

ERAS: Enhanced recovery after surgery

Table 2

Demographic data and patient characteristics

		ERAS (+) n=60 (%)	ERAS (-) n=32 (%)	Total n=92 (%)	p
Age (years)	Mean±SD	48.9±13.7	50.2±14.7	49.4±14	0.663
	Median (min-max)	50.5 (20-81)	47.5 (30-86)	49.5 (20-86)	
Gender (%)	Female	22 (36.7)	9 (28.1)	31 (33.7)	0.409
	Male	38 (63.3)	23 (71.9)	61 (66.3)	
Body mass index (kg/m2)	Mean±SD	27±4.5	27.4±4.5	27.1±4.5	0.699
	Median (min-max)	26.6 (18.7-37.9)	28.2 (18-34.8)	27.5 (18-37.9)	
ASA (%)	1	19 (31.7)	11 (34.4)	30 (32.6)	0.570
	2	37 (61.7)	17 (53.1)	54 (58.7)	
	3	4 (6.6)	4 (12.5)	8 (8.7)	
DM (%)	yes	51 (85)	26 (81.3)	77 (83.7)	0.643
	no	9 (15)	6 (18.7)	15 (16.3)	
Smoking (%)	yes	51 (85)	24 (75)	75 (81.5)	0.239
	no	9 (15)	8 (25)	17 (18.5)	
Spine level (%)	L5-S1	22 (36.7)	8 (25)	30 (32.6)	0.444
	L4-5	31 (51.7)	20 (62.5)	51 (55.4)	
	L3-4	4 (6.6)	4 (12.5)	8 (8.7)	
	L2-3	2 (3.3)	-	2 (2.2)	
	L1-2	1 (1.7)	-	1 (1.1)	

ERAS: Enhanced recovery after surgery, ASA: American Society of Anesthesiologist, DM: Diabetes mellitus, SD: Standart deviation

Table 3

Surgical and outcome parameters

		ERAS (+) n=60 (%)	ERAS (-) n=32 (%)	Total n=92 (%)	p
Surgical time (minutes)	Mean±SD	61.5±28.9	68.3±28.5	63.0±28.8	0.182
	Median (min-max)	50 (25-150)	59 (35-135)	53.50 (25-150)	
Blood transfusion (%)	yes	59 (98.3)	30 (93.8)	89.0 (96.7)	0.276
	no	1 (1.7)	2 (6.2)	3 (3.3)	
LOS (hours)	Mean±SD	25.5±12.5	34±20.1	28.5±15.9	0.002
	Median (min-max)	23 (14-96)	26 (16-98)	24 (14-98)	
Spondylodiscitis (%)	yes	58 (96.7)	27 (84.4)	85 (92.4)	0.034
	no	2 (3.3)	5 (15.6)	7 (7.6)	
Reoperation (%)	yes	59 (98.3)	30 (93.8)	89.0 (96.7)	0.276
	no	1 (1.7)	2 (6.2)	3.0 (3.3)	
Follow-up (months)	Mean±SD	14.1±7.8	15.9±5.7	14.7±7.2	0.323
	Median (min-max)	14.5 (3-27)	17 (4-24)	16 (3-27)	

ERAS: Enhanced recovery after surgery, LOS: Length of stay, SD: Standart deviation

Table 4

Preoperative and postoperative VAS scores

		ERAS (+) n=60	ERAS (-) n=32	Total n=92	p
Preop VAS (Lumbar)	Mean±SD	7.5±1.1	7.9±0.9	7.6±1.1	0.540
	Median (min-max)	8 (6-10)	8 (6-10)	8 (6-10)	
POD 1 VAS (Lumbar)	Mean±SD	3.6±1.2	3.2±0.9	3.4±1.1	0.101
	Median (min-max)	3 (2-7)	3 (2-6)	3 (2-7)	
POD 10 VAS (Lumbar)	Mean±SD	2.6±1.1	2.6±0.9	2.6±1.1	0.763
	Median (min-max)	2 (1-5)	3 (1-5)	2 (1-5)	
POD 45 VAS (Lumbar)	Mean±SD	2.0±0.9	2.4±1.5	2.1±1.1	0.173
	Median (min-max)	2 (1-5)	2 (1-6)	2 (1-6)	
Preop VAS (Radiculopathy)	Mean±SD	9.2±0.90	9.1±0.8	9.1±0.9	0.778
	Median (min-max)	9 (7-10)	9 (7-10)	9 (7-10)	
POD 1 VAS (Radiculopathy)	Mean±SD	2.7±0.8	2.4±0.8	2.6±0.8	0.091
	Median (min-max)	3 (1-5)	2 (1-5)	3 (1-5)	
POD 10 VAS (Radiculopathy)	Mean±SD	1.9±0.9	1.8±0.8	1.9±0.9	0.653
	Median (min-max)	2 (1-5)	2 (1-4)	2 (1-5)	
POD 45 VAS (Radiculopathy)	Mean±SD	1.5±0.7	1.6±0.8	1.5±0.7	0.592
	Median (min-max)	1 (1-4)	1 (1-4)	1 (1-4)	

ERAS: Enhanced recovery after surgery, VAS: Visual analog scale, POD: Postoperative day, SD: Standart deviation

It has been reported that patients with hemoglobin levels below 13 mg/dl are risky in the perioperative and postoperative periods. Anemia is a high-risk factor for postoperative complications and mortality[14,15]. ASA reported that hemoglobin levels above 8 mg/dl reduce the risk of perioperative complications in surgical patients with cardiac, renal, or pulmonary comorbidities[1,16]. In patients with preoperative electrolyte disorders, the preoperative fluid balance may not be achieved, and adverse events such as diabetes insipidus and inappropriate antidiuretic hormone secretion may develop during and after the operation, leading to serious morbidity or mortality. Preoperative patients should not remain dehydrated in terms of both preserving kidney functions and maintaining electrolyte balance[12]. Therefore, preoperative normovolaemia should be ensured and any fluid-electrolyte imbalance should be treated[17].

It is recommended to avoid long-term fasting before the operation, to consume light solid food up to 6 hours before the operation, or to provide oral carbohydrate support before the operation[1,16]. It has been reported that consumption of 400 ml oral carbohydrate-rich drink (400 ml water, 50 g glucose) 2-3 hours before anesthesia, and 800 ml carbohydrate-rich drink at night before the surgery provides decreased postoperative insulin resistance, muscle strength, and body weight protection, increased cardiac activity, and decreased myocardial damage.[18] It has been observed that the administration of prophylactic intravenous antibiotics approximately 30 minutes before the incision reduces the surgical site infection rates[16].

It is aimed to prefer short-acting general anesthetic agents such as propofol so that the patients wake up quickly with minimal residual effect. Sevoflurane or desflurane, which is short-acting inhalation anesthetic agents, are preferred for maintaining anesthesia. The use of nitrous oxide is not recommended because of the delayed residual effect and the high probability of postoperative nausea and vomiting[19,20]. Intraoperative fluid therapy aims to provide intravascular volume, cardiac output, and tissue perfusion while preventing sodium and fluid overload. Crystalloid and colloid-derived fluids may be preferred according to the cardiac capacity and bleeding volume of the patients. Inotropic agents such as Dopamine, can be used in case of excess fluid imbalance to increase intravenous volume[16].

The decrease in room temperature, blood loss, the effect of the anesthetic agents on the thermoregulation center, and the direct or vascular involvement of the hypothalamus in the intracranial tumor, arteriovenous malformation, and aneurysm surgeries increase the possibility of hypothermia in patients[16]. It is recommended to heat anesthetic gases and intravenous fluids and to use heater blankets to maintain body temperature. Studies have shown that the use of surgical drains is not associated with reoperation or mortality rates. However, routine use of drains is not recommended because of increased infection rates[16].

The persistence of postoperative nausea and vomiting may cause many problems. Dehydration of patients due to excessive fluid loss and restriction in water intake, and delayed feeding cause a lack of nutritional support and lengthen patients' discharge time. Prevention of nausea and vomiting begins in the preoperative period. Avoiding the use of nitrous oxide and opioid analgesics reduces the risk of nausea and vomiting[21-23]. Some studies have shown that preoperative oral carbohydrate support can reduce the rate of postoperative nausea and vomiting[16]. It is recommended to start oral intake 4 hours after the operation[16,24,25]. It has been stated that oral fluid intake should be started 4 hours after surgery, and soft solid foods or nutritional support fluids can be given after an average of 8 hours[23].

Accurate analgesic treatment is important for postoperative bowel function recovery, early mobilization, decreased complication rates, and shorter hospital stay. It is aimed to reduce the side effects of each drug by using various pain mechanisms with multimodal analgesia[26]. Urinary catheterization is directly related to infection and delayed postoperative mobilization. Early removal of the urinary catheter can significantly reduce the risk of urinary infection and it is recommended to remove the urinary catheter within 1 to 3 days after the surgery[16,21-23].

Patients with high-risk factors such as iatrogenic neurodeficits, obesity, steroid use, advanced malignancy, cardiac arrhythmias, and genetic diseases affecting the coagulation cascade should be followed carefully for possible thromboembolism in the postoperative period[16]. There are medical and mechanical treatment options for postoperative thromboembolism prophylaxis. Anti-embolism stockings and intermittent pneumatic compression devices are recommended for mechanical prophylaxis. Pharmacological thromboprophylaxis with low molecular weight heparin has been shown to reduce the incidence of symptomatic venous thromboembolism and also overall mortality with a very low risk of bleeding complications[16,27]. Early mobilization is an important predictor for the rapid recovery of patients after surgery. Prolonged bed rest has disadvantages including decreased muscle strength, insulin resistance, and increased thromboembolic and pulmonary complications[27].

The retrospective nature of the study and the relatively small sample size are the main limitations of the present study. The lack of 5-year follow-up of all patients is also another limitation. Nonetheless, this study also has several strengths. Demographic data of the patient groups are similar, there is no statistically significant difference between the patient groups, and all surgeries were performed by the same surgeon group in the same period.

5. Conclusions

ERAS protocols are designed to reduce the complication rates of surgical interventions and health expenditures. The present study also demonstrates that ERAS protocol reduces LOS in hospitals, and spondylodiscitis rates in lumbar microdiscectomy surgery. Reduction in these parameters may decrease health expenditures in accordance with the literature. We conclude that ERAS protocols should be encouraged and applied more widely in spine surgeries.

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Statement of ethics

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by Cukurova University Hospital Medical Ethics Committee with the decision no. 133 dated 2023.

Conflict of interest statement

The authors declare that they have no financial conflict of interest with regard to the content of this report.

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Author contributions

All authors contributed to the study conception and design. All authors read and approved the final manuscript.

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